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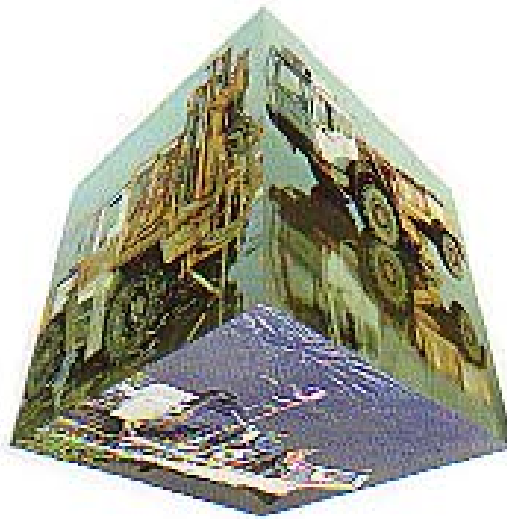
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1. Preface



1 PREFACE

Everyone involved in the geophysical industry is accountable to themselves, their families, their fellow workers, their employers and their clients to work in a safe and responsible manner, follow established rules, comply with local regulatory requirements and follow their company's policy.

All personnel should challenge and report all unacceptable HSE situations, incidents, (accidents and near misses), whenever or wherever they occur, to their supervisor.

Always Remember: *Common Sense Is Not So Common.*

Do not expect others working with and around you to always see potential hazards the same way. All geophysical personnel should work together and communicate their experiences and knowledge to ensure there is a shared perception of the risks.

The quality of the geophysical industry's work is dependent on our skilled and experienced personnel. Accidents deplete this invaluable resource. The IAGC hopes that the use of this manual will lead to greater HSE awareness throughout the industry and improve performance for all operators.

The IAGC encourages all employees to read this manual and to become familiar with its content.

1.1 Purpose

Geophysical operations are hazardous. The objective of this manual is to highlight areas of concern and to provide industry best practice guidance to manage risks in the workplace.

We have attempted to make the manual as user friendly and as complete as possible. However, it is intended as a supplement to and not a replacement for, the internal HSE policies and procedures used by companies to control and mitigate all hazards at all work locations.

Additional guidance on specific topics may be found in the material noted in the references section of this manual.

Geophysical companies throughout the industry are expected to comply with all applicable laws, regulations and permit conditions while applying prudent operating practices and procedures in the conduct of their work.

The IAGC does not represent that this or any other edition of the IAGC Land HSE Manual is entirely comprehensive, accurate or covers each and every HSE topic or risk, which may be encountered by those using this manual and disclaims all responsibility and liability for any such utilization of the manual by the users thereof. By receipt of the IAGC Land Geophysical HSE Manual, the recipient or user agrees to release, indemnify and defend the IAGC from and against any and all claims, demands and liabilities that may arise from the utilization of the manual by such recipients or users.

Additional copies of this manual can be obtained from: www.iagc.org

1.2 Scope

This manual is designed as a guide for geophysical field operations. The collective worldwide incident experience of many geophysical operators and their clients provides the underpinning of the content, which has been organized in such a way that individual HSE subjects can be addressed at HSE meetings and/or HSE training sessions.

1.3 Definitions

Throughout this manual, terms and definitions are used in accordance with the OGP Glossary of HSE Terms. If you are in doubt of the meaning of a word or term in any part of this manual, ask your supervisor to advise you.

1.4 References

- Atlas Powder Company, Explosives and Rock Blasting, 1987
- Blaster's Handbook, E. I. Du Pont De Nemours and Co., 1980
- Institute of Mining Engineers (IME), Safety Library Publications
- Bureau of Alcohol Tobacco and Firearms (BATF), Explosives Law and Regulations
- Occupational Safety and Health Administration, (OSHA), Safety and Health Standards 29 CFR, 1926/1910
- Department of Transport (DOT), Hazardous Materials Regulations, 1983
- IAGC Publications
- All Terrain Vehicle (ATV) Safety Institute Training Material for Rider Course
- International Snowmobile Manufacturers Association Snowmobile Safety and Certification Committee
- **International Association of Geophysical Contractors (IAGC)**
 - **Land Marine Operations Safety Manual, tenth Edition.**
 - **Environmental Manual For Worldwide Geophysical Operations (Millennium Edition)**
 - **Guidelines on the use of Workboats in Marine Geophysical Operations**
 - **Security Statement of Principles**
 - **Minimum Offset Guidelines**
- **The International Association of Oil and Gas Producers (OGP) (formerly E&P Forum)**
 - **HSE aspects in a contracting environment for geophysical operations - OGP reference 432**
 - **M1 Guidelines for the development and application of health, safety and environmental management systems - OGP reference 6.36/210**

- **M2 HSE Management: guidelines for working together in a contract environment - OGP reference 6.64/423**
- **M3 HSE competence assessment and training guidelines for the geophysical industry - OGP reference 6.78/292**
- **M4 Guidelines for HSE auditing in the geophysical industry - OGP reference 6.53/245**
- **H1 Managing Health for field operations in oil & gas activities - OGP reference 343**
- **H1 Substance abuse: A guide for managers and supervisors in the oil and gas industry- OGP reference 445**
- **H5 Guidelines for the control of HIV, Hepatitis B and C in the workplace - OGP reference 6.55/321**
- **H6 Health aspects of work in extreme climates - OGP reference 398**
- **S1 Aircraft management guidelines - OGP reference 390**
- **S2 Watercraft & water in geophysical operations – a guide to operations and management – OGP reference 355**
- **S3 Land transportation safety recommended practice - OGP reference 365**
- **S4 Guidelines on permit to work systems - OGP reference 6.29/189**
- **E1 Environmental management in oil & gas exploration & production- OGP reference 2.72/254**
- **E2 Oil & gas exploration & production operations in mangrove areas - guidelines for environmental protection - OGP reference 2.54/184**
- **E3 Oil industry operating guideline for tropical rainforests - OGP reference 2.49/170**
- **E4 Oil & gas exploration & production operations in mangrove areas - guidelines for environmental protection - OGP reference 2.54/184**
- **E5 Oil & gas exploration & production in arctic & subarctic offshore regions - guidelines for environmental protection - OGP reference 329**
- **E6 Guidelines for Waste Management - OGP reference 413**
- **OGP Human Factors**

- **CAGC Documents:**
 - **CAGC Best Practice on Misfire Management**
 - **CAGC Best Practice on Geophysical Mulcher Operations**

1.5 Acknowledgments

This tenth edition of the IAGC Land Safety Manual for Geophysical Field Operations would not have been possible without the dedicated work of numerous geophysical industry representatives, including both operating managers and safety professionals from throughout the world.

The result is a comprehensive safety manual that should provide invaluable assistance to companies and individuals who wish to ensure the highest degree of safety in their field activities. We hope the manual, in conjunction with the other safety initiatives and programs offered by our association, will lead to greater safety awareness throughout the industry and to improved safety performance.

To the following individuals and companies, we offer our sincere appreciation and commendation for a job well done:

Murray Saxton	Geokinetics
Mark Nelson	Dawson Geophysical
Jean Monerol	CGGVeritas
Craig Massey	CGGVeritas
David Rash	Geokinetics
John Barrett	Global Geophysical
Mike Covil	Technical Editor

The IAGC is sad to say goodbye to a longtime friend and colleague Mike Colvil. During his career in SSL, Mike worked as a field technician, party chief and later as a regional manager. He then took over the chief HSE role in SSL for several years working globally. When he retired, he became what some would call the “the UK based arm of IAGC” for many years and contributed significantly to many IAGC activities including various revisions of this manual through its development to date. He also shared his knowledge through consulting and training, not least a short period in China presenting courses with me where he was highly respected for his knowledge, experience and never ending enthusiasm.

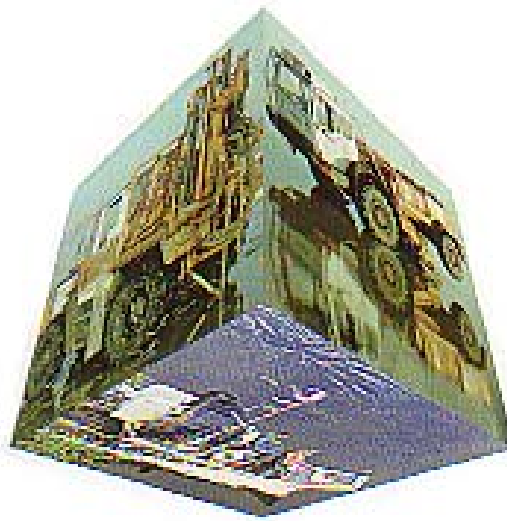
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2. HSE Management Systems



2 HSE MANAGEMENT SYSTEMS

HSE management systems are a major part of the Geophysical industry's efforts to avoid incidents. All personnel should make themselves familiar with their own Company's HSE Management System (HSE MS). This manual highlights some of the key aspects of HSE.

Typically the elements of an HSE Management System are:

- **Leadership & Commitment**
 - top down commitment and company culture.
- **Policies & Objectives**
 - corporate intentions, principles of action and aspirations with respect to HSE.
- **Organization, Resources, and Documentation**
 - organization of people, resources and documentation for sound HSE performance.
- **Risk management**
 - identification and evaluation of HSE risks, for activities, products, and services, and development of risk reduction measures.
- **Planning**
 - planning the conduct of work activities including planning for changes and emergency response.
- **Implementation & monitoring**
 - performance and monitoring of activities, and how corrective action is to be taken when necessary.
- **Audit, Review and Improvement**
 - periodic assessments of system performance, effectiveness and fundamental suitability.

2.1 Planning

All geophysical work should be planned to include resources to assure that training, community relations and auditing activities should take place. Guidelines for each activity follow.

2.2 Supervising and Managing Workplace HSE

Supervisors and visiting management should demonstrate, follow and promote safe practices. This is essential in demonstrating leadership & commitment to HSE. There should be a visible expression of commitment by supervisors. HSE is a line responsibility. Furthermore, supervisors should empower and communicate to all individuals of their obligation and individual right to stop or intervene in any activity that could potentially harm people, the environment or assets. They should also communicate that all personnel have a duty of care for all their fellow workers.

Visiting managers should participate in crew HSE meetings and discuss the crew's HSE goals and objectives. They should also recognize HSE performance when these objectives are achieved

Visiting managers should always participate in site orientations the same as all visitors to the crew and take part in crew inspections or audits at a defined schedule.

2.3 Regulatory and Contractual Requirements

Everyone needs an awareness of the governing regulations that affect the work or the activities of the people they have responsibility for in the work place. Regulatory and contractual requirements should be identified early in planning a project and documented in the crew's Project HSE Plan.

2.4 HSE Training

Because geophysical work exposes personnel to unique and ever-changing hazards and potential for incidents, training is one of the most important elements of an effective program of work. Adequate and effective training and verification of competency can significantly reduce incidents.

The need for HSE training spans all segments of IAGC member companies, from the field crew labor up through supervision to headquarters management.

Each company should have a defined minimum level of training for all personnel. The employee should have completed this minimum training before commencing work. Note that some additional training may continue on the crew to develop an employee's knowledge further.

Training may be mandated by law in some jurisdictions as well as contractually required. Responsibility for compliance rests with line management as much as with individual employees.

2.4.1 Required Basic Training

Training should include hazards present and PPE use and first aid, emergency response procedures, company and client policies, governmental regulations, and hands on training for the particular task: i.e. drilling. In addition, any pertinent regulatory, contractual or permit issues should be known before beginning work. Such awareness is equally important for visitors to the worksite. The crew should also maintain training records.

All employees should receive a basic HSE training. Some jurisdictions mandate specific training in such issues as hazardous chemicals in the workplace and blood borne pathogens. Some training, such as the use of Personal Protective Equipment (PPE) and procedures for H₂S, can save lives.

The timing of training events can be critical to improving HSE performance. Sufficient time for training on geophysical crews should be part of the mobilization phase of the contract HSE plan.

- 1) Pre-Employment. Records of prior training should be considered in planning for new employees' training needs. Many companies utilize a "training passport" to document employee training.
- 2) Induction/Orientation. Hazards and Personal Protective Equipment (PPE) should be understood before beginning work on a new job or job site.
- 3) On-The-Job-Training. Coaching, hands on demonstration of tasks. (competence should be documented)
- 4) Regulatory Training. This should be provided as required by law or contract.
- 5) Verification of Competency. Competency should be verified upon conclusion of the training. A fire drill is an example of a method of verifying competency.
- 6) HSE Meetings. Departmental HSE meetings should be held for the crew (usually weekly), and crew HSE committee meetings (usually monthly). Daily toolbox / tailgate meetings of 5-10 minutes duration for all crews, i.e. survey, drill, recorder.
- 7) Refresher Training. Some refresher training may be needed. For example if the job task content changes or if new techniques, tools, equipment or Personal Protective Equipment (PPE) have been introduced. See Management of Change.

2.4.2 Training Locations

The location of training events can vary with job site circumstances.

- 1) The Worksite. Training can occur at the worksite where actual examples can be demonstrated and competence verified.
- 2) The Crew Office/Shop/Loading Zone. Numerous crew members congregate just before work begins and at the conclusion of the workday, making it easy to conduct training.
- 3) Offsite. Offsite facilities tend to ensure attention and adequate visual aids. Offsite training is available in most areas, scheduling and course size limitations need to be considered.
- 4) Headquarters. Corporate headquarters training can have a positive effect on awareness and commitment of top management.

2.4.3 Competency Based Training Assessments

Training and competency assessment programs should be aligned with *OGP M3 - HSE competence assessment training guidelines for the geophysical industry Report No: 6.78/292 - June 1999*. This document outlines the standard requirements for the geophysical industry.

Competency assessments & verification should be included in line with the OGP reference above to ensure that employees have the required skills, knowledge and experience to complete the work they are assigned. It is also

important that the hazards they are exposed to are understood and work can be performed in compliance with good practices and procedures.

2.4.4 Short Service Employees (SSE)

New employees (also called short service employees) are more liable to incidents in the work place and therefore need to be identified and supervised until they are deemed competent to carry out their work safely. The goal of the SSE program is to heighten the visibility of new workers and prevent injuries during their initial months of service and to designate experienced employees who demonstrate their commitment to safety through personal action mentoring the new employees until such time when they are deemed competent to carry out work on their own.

A SSE program should:

- Help to reduce the number of new employee injuries
- Develop of a positive company HSE culture
- Heighten visibility of new workers
- Recognize experienced employees
- Encourage employees to approach each other & have safety related conversations

A recognition system using (a **green** sticker or arm band) helps identify new workers stating:

- I am new to my job or the site
- I probably have a lot of questions about safety, but am not sure who to ask
- I need your help with doing my job safely, so please introduce yourself, offer your advice, and be patient with me

A recognition system using (a **gold** sticker or arm band) helps identify a new worker's mentor stating:

- I value safety and am committed to talking to my coworkers about safety
- I want you to approach me if you see me doing something that may be unsafe
- I will approach you if I see you doing something that may be unsafe
- I have volunteered to wear the a gold sticker or arm band to help you

2.5 HSE Orientation / Induction

Immediately upon joining a new crew, forming a new crew, or moving into a new worksite area, personnel should be given a site specific orientation to advise them of all factors that may affect their personal safety and health and their HSE responsibilities.

The site manager is responsible for ensuring that each person who visits a work location receives a documented HSE orientation relevant to the site as soon as possible after arrival and before exposure to work hazards.

Immediately upon joining a crew or moving into a new area, geophysical personnel need to be made aware of the local factors that may affect their personal safety. Such factors would normally include:

- 1) Emergency response procedures.

- 2) The layout of the camp including the location and operation of safety equipment, first aid kits, alarm points and muster stations.
- 3) Firefighting equipment and evacuation plan.
- 4) Site specific hazard communication.
- 5) Job and associated local hazards, controls & mitigations.
- 6) Company HSE policies, procedures & work instructions.
- 7) Roles and responsibilities.
- 8) Safety rules and reporting procedures.
- 9) Site specific training as required
- 10) The written safety orientation sheet (given to each person).
- 11) Ensure that each person has adequate Personal Protective Equipment (PPE)
- 12) Chain-of-command and key personnel.
- 13) A next of kin and medical information sheet should also be filled in

2.6 HSE Meetings

Regularly scheduled, well-organized, chaired and properly conducted HSE meetings should be held to discuss issues that may have arisen during the progress of the work. The crew should maintain reports of these meetings, including attendance records and meeting minutes. Each meeting should have an agenda and a pre-defined chairperson. Frequent meetings of adequate duration should also be conducted to discuss specific hazards and to review incidents that have occurred and cross learning.

Meetings serve different purposes so it is important to consider what the objective of the meeting is.

Meetings can be for:

- information giving
- information seeking and information exchange, such as reviewing hazards
- new ideas
- problem solving and decision making
- introducing change
- planning

Effective HSE meetings are:

- Planned with an agenda & have a chairperson of leader
- All persons are heard equally and encouraged to give opinions

- Clear decisions are made with an action plan
- Flow easily closing each item before moving on
- Kept to the agreed timeline
- Have breaks every hour or as determined
- Pleasant to be in because contributions are valued
- ALL ARE ENGAGED & MOTIVATED

2.6.1 Kick Off Meetings

Kick off meetings or job start up meetings are conducted at the start of new projects. These meetings are designed to communicate a client's expectations, discuss the project HSE plans and to communicate job specific hazards and how they will be controlled. It is common to have shift leaders and department heads attend these meetings with the client and crew party chief. On some operations it will be expected that all personnel attend so that project specific training and information can be delivered to all the crew.

2.6.2 Toolbox / Tailgate Meetings



Toolbox / tailgate meetings should be a general practice before work starts each day / shift, and as an intervention measure when unexpected conditions arise at work. These meetings are intended as a discussion on the hazards and risks associated with the task and are an opportunity to conduct a risk assessment prior to commencing work. Meeting topics may include review of procedures, examples of good practice as well as discussing incidents, etc. Delivery should be interactive with workforce, using questioning techniques rather than a supervisor telling people what to do.

The Toolbox/Tailgate meeting should always include last minute risk assessment as well.

2.6.3 HSE Committee Meetings

An HSE committee should assist line management in HSE issues. HSE committee meetings can be designed to:

- identify team goals
- identify tasks to achieve team goals
- allocate tasks to team members
- develop work plans
- discuss how individuals' tasks affect the work of the team
- plan new directions
- discuss difficulties or resolve issues that have been identified on the crew

2.6.4 General Crew Meetings

Regularly scheduled, well-organized and properly conducted HSE meetings should be held. A report of these meetings, with attendance records, should be maintained. IAGC has publications including this manual that

would be helpful to you in these meetings. It is common practice to organize these meetings along the lines of the crew structure, i.e., drillers, drivers, etc.; crews usually meet separately to discuss subjects specific to their work. **It is important that line management takes a leadership role in general meetings to deliver the key points in regard to HSE commitment.**

2.7 Incident Reporting & Investigation

All incidents (accidents and near misses), hazardous situations, unsafe acts and conditions should be reported as per the Company procedures, client or regulatory requirements.

All incident reports and high potential events should be investigated, reviewed, and actioned in an effort to prevent future occurrence of a similar event.

2.8 Inspections & Audits

Inspections are conducted at crew level and are usually supported by check lists. The crew may also conduct cross inspections (sometimes incorrectly called cross audits), one department inspecting another. These should be planned and cover critical activities.

Audits often begin in the corporate offices to assess the documentation of the existing HSE management system and its effective functioning. They proceed to the field operation to assess performance to the system's procedures. An important element of the auditing and inspection process is the follow up procedure. Audit and inspection findings should trigger recommendations and actions which should be recorded in the crew action points register.

Audit teams comprised of combinations of crew management and client, under the leadership of a qualified auditor, are the most effective. Audit should follow contractual requirements and good industry best practice.

Crews should be audited on an internal basis to ensure adherence to Company systems, policies, standards, guidelines, work instructions, and processes. Any deficiencies or non-conformances should be actioned and corrected as part of a remedial work program.

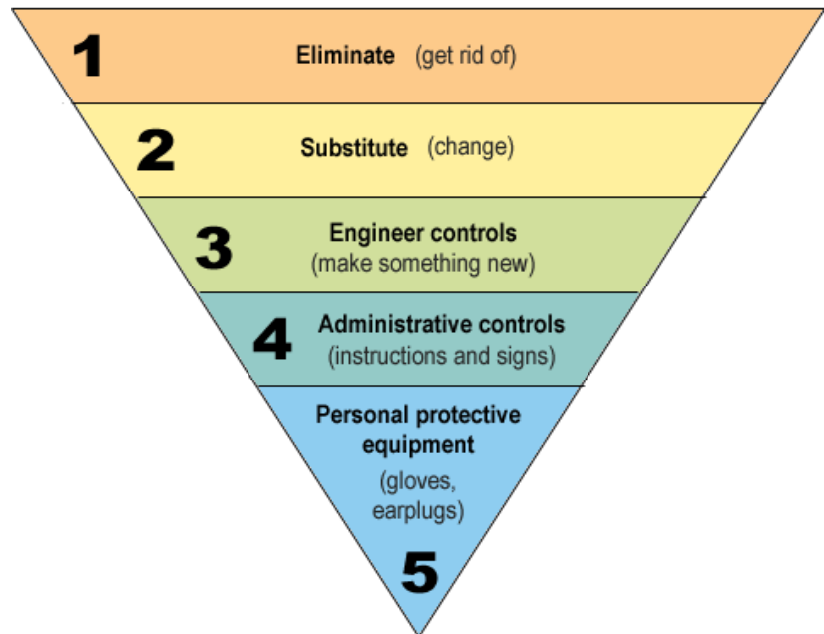
Clients may conduct external audits to ensure compliance with their Management System requirements.

Frequency of audits and inspections should be set out in the Project or Crew HSE Plan. Inspections are more frequent (typically daily to monthly) than audits.

Note: an audit is not the same as an inspection. An audit is much more formal and requires a competent auditor to lead the audit. Inspections are normally conducted to verify compliance with the rules or procedures while audits are designed check the overall effectiveness of the HSE Management System.

2.9 Hazard Management

All personnel should be trained to identify workplace hazards and control them using a hierarchy of controls. The following hierarchy should be used:



2.9.1 Hierarchy Of Controls

Elimination	The job is redesigned or the substance is eliminated so as to remove the hazard.
Substitution	Replace the material or process with a less hazardous one. For example, replace flammable solvents with non-flammable types.
Engineering controls	Install or use additional machinery such as local exhaust ventilation to control the risk. Separating the hazard from operators by methods such as enclosing or guarding dangerous items of machinery. For example, use guards or screens around machine.
Administrative controls	Reduce the time the worker is exposed to the hazard. Develop procedures or work instructions. Provide training. Perform risk assessments. Increase safety awareness signage.
Personal Protective Clothing and Equipment	<p>Applied as the last line of defense & a back-up in case one of the previous measures fails in controlling the risks to a reasonably practicable level. PPE should not be considered a front line control.</p> <p>If chosen, PPE should be selected and fitted to the person who uses it. Workers should be trained in the function and limitation of each item of PPE. For example, an operator should know to wear a fall harness correctly.</p>

2.9.2 Hazard Register

A site-specific hazard register, which include measures to eliminate or manage risks associated with these hazards, should be developed in advance of the work. A generic hazard register may include all known hazards in an organization but it is important to identify project specific hazards prior to mobilizing on any new project.

A hazard register should reference the specific controls that are required to reduce risk to acceptable levels, i.e. as low as reasonably practicable (ALARP).

2.10 Conducting Tasks

Each employee needs to know the safe way to perform their tasks and the consequences that are possible if those tasks are not conducted safely. Capability to perform the work in the prescribed ways should be verified. A critical task analysis could be conducted to identify those tasks that have the greatest exposure. Procedures or safe work instructions should be developed to control the risk associated with critical tasks and mitigate the

potential consequences of failure. These procedures or safe work instructions should be augmented prior to work activities using a hazard analysis tool such as the Job Safety Analysis (JSA) or Task Hazard Assessment (THA).

2.11 Emergency Response

The best plan is to avoid having an emergency, proper assessment and planning reduces the likelihood of an emergency and its severity. An emergency plan (ERP) should be prepared before work starts. The ERP should be consistent with ERPs that exist at higher levels and where necessary have references to them.

The Emergency Response Plan (ERP) should be posted at each notice board and copies kept with every radio room and key point locations. Emergency Response Plan (ERP) training should be given to all inductees at job start and at regular intervals thereafter or when the operation changes. Both the company and the client need emergency reporting procedures for government agencies.

In addition, facilities such as base camps, shops, hotels, barges, houseboats and major ships, should train an Emergency Response Plan (ERP) team. The team's responsibilities should include evacuating all personnel from the facility in case of fire and ensuring that all personnel are accounted for.

A system of checking who is in camp or on the crew should be maintained. This could be linked to the journey management system. It is important to know exactly who is on the crew at any one time and, what is more important, where they are. This information should be available to the Emergency Response Plan (ERP). Team immediately an emergency occurs.

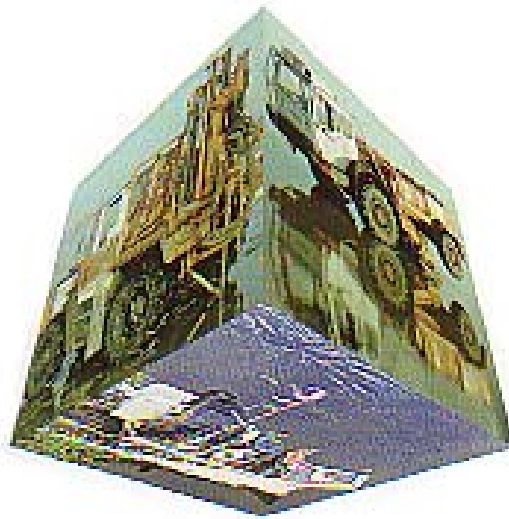
Consider developing the following plans if relevant:

- Significant hydrocarbon spills.
- Other waste spills or environmental damage.
- Damage to wells, pipelines and other surface structures.
- Fires and explosions in base camp or work area.
- Medical evacuation.
- Severe weather such as lightning, hurricane, tropical storm, floods , etc
- Earthquake, tsunami and other possible natural disasters.
- Man lost and Man overboard, Search and Rescue.
- Abandonment, i.e. total evacuation.
- Security, hostage taking. Civil unrest.

In addition:

- 1) Resources, material and personnel should be provided to recover from each of the above scenarios.
- 2) Determine resource location and assign individuals with authority to access resources on activating the Emergency Response Plan (ERP).
- 3) If needed, make the Emergency Response Plan (ERP) a booklet, include maps of the prospect area, significant access, local hospitals, helicopter landing zones with geographical coordinates, etc that can be easily distributed to the crew.
- 4) Contact names and telephone numbers of key personnel from the company, client and third parties (hospitals, fire brigade, police, military) should be included.
- 5) Define key steps and procedures needed to recover from these incidents to get back to work.
- 6) Assign a named Emergency Response Coordinator for each work location.

3. Human Factors



3 HUMAN FACTORS

Human factors is the term used to describe the interaction of the workers with each other, with facilities and equipment, and with the HSE Management System. This interaction is influenced by both the working environment and the culture of the people involved. What may be a good system of work in one region may be found to be less than ideal in an area where culturally driven attitudes to risk taking may be significantly different.

It is now more important than ever to consider Human Factors in all geophysical operations as this helps us to better identify, control & mitigate the potential hazards in each project. Below is a description of how we have progressed in the industry in reducing incidents.

1. The **first stage** of incident prevention in the industry was to engineer good design into specific tasks, (e.g. the use of automated systems to reduce the number of individuals required to accomplish a task.)
2. The **second stage** was to develop HSE Management Systems to reduce risks to as low as is reasonably practical (ALARP). This was achieved by establishing and implementing, well-documented procedures, training programs, conducting resource reviews, and developing effective incident reporting systems to learn from our mistakes.
3. The **third stage** now is to incorporate Human Factors and consider human behavior. From an individual's standpoint the third stage is the most important because it is here that all personnel become more aware of their interactions with the HSE Management Systems & take responsibility for their own actions and the actions of others around them, in an effort to promote teamwork and a safer work environment. Individual behavior turns the HSE Management System into a functional reality.

At this third stage **situational awareness** is the driving force in preventing incidents.

It is important to note that this does not place all responsibility on the individual. Management still has a responsibility to provide a safe working environment for the crew at all times.

3.1 Improving HSE Performance

The geophysical industry has been successful in reducing incident frequency by adopting improved engineering solutions and HSE Management Systems but HSE performance has reached a plateau in many companies.

The graph below shows how the rate of incidents in the industry has been reduced over time as described in the three steps listed above.

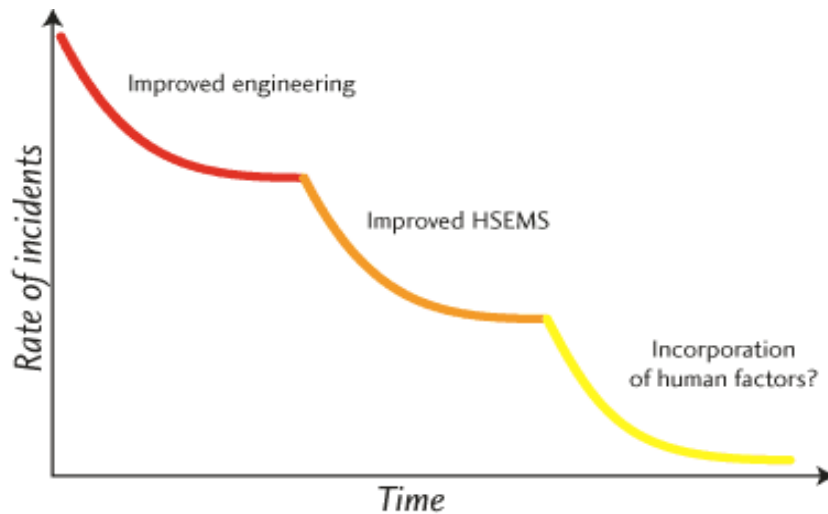


Figure 1 - Graph from OGP Human Factors

Continued progress will come by taking better and more explicit account of the way we interact with every aspect of the workplace and how these interactions may create hazards.

We need to consider how we interact with each other, facilities, equipment, and management systems we are working with. All of this, in turn, should also be understood within the context of the local culture and environment we are working in.

Below is a list of issues that should be considered when evaluating Human Factors on a crew:

Are procedures & written work instructions being used and referenced or are they just sitting on a shelf in a binder? Are these documents used for discussion for planning work activities? Are simple checklists available as an aide memoire?

Does the crew have adequate knowledge, training and experience to operate the equipment they are using? Are there competency checks for operating safety critical equipment?

Do risk assessments conducted prior to work activities identify?

- hazards that exist in within the system that is being worked on
 - i.e. stored energy, motion, chemical, radiation, electrical, gravity, heat / cold, biological, pressure
- hazards that workers introduce into a work environment
 - i.e. tools, equipment, untrained personnel, fatigue
- hazards that the surrounding working environment presents
 - i.e. simultaneous operations, wind, weather, ambient light
- Are there elements with people working together? .Are there communication issues with coworkers, maybe a language or cultural barrier preventing the flow of important information such as a shift

turnover or interpreting instructions? Recognizing and then acting on communication issues with others will help prevent errors. Again, awareness is the key

These types of factors, unless recognized, have the potential to have a negative outcome on the HSE performance of the crew.

Educating the crew and creating an awareness of how these factors influence ones decision making process is the first step. Putting this tool into the hands of the crew to practically apply this concept will reduce errors and help prevent incidents.

Below is a diagram that shows the relationship of the three elements that should be evaluated.

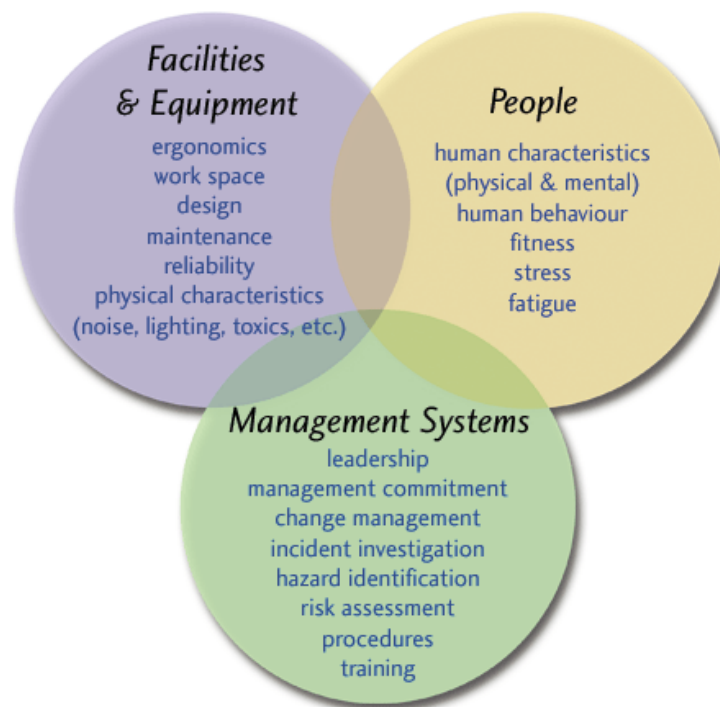


Figure 2 - OGP Human Factors

3.2 HSE Culture

Culture can be defined as shared set of beliefs of what is important and a belief in how things work in the company or on a specific crew. The goal for any geophysical company is to promote proactive behavioral

norms (*it's the way we do things around here*¹). Management commitment and leadership is the primary driver behind this, generating employee involvement with shared responsibility based on open and honest communication.

HSE Culture has a major impact on personal behaviors. The challenge for each team is to recognize its own safety culture and identify how it may be improved over time.

¹ OGP Human Factors.

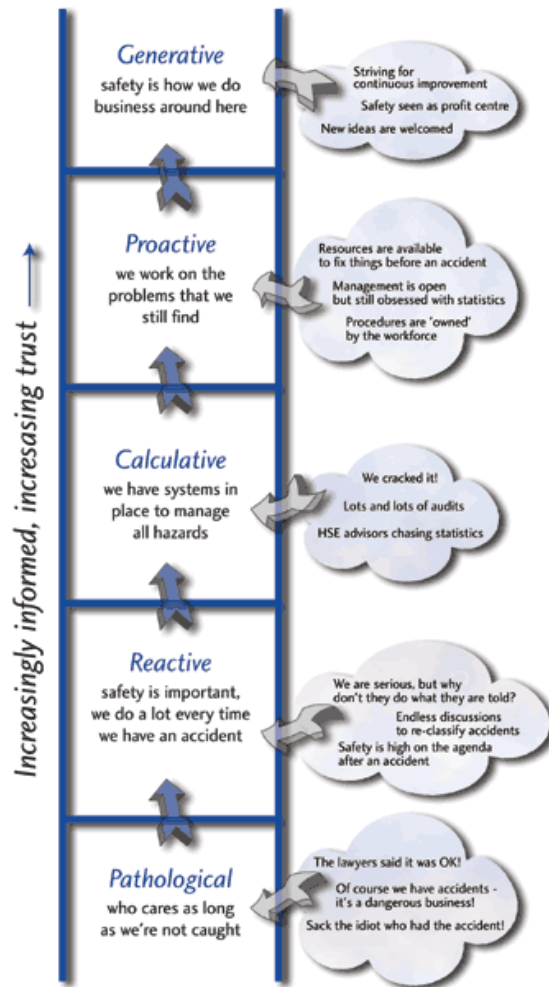


Figure 3 - OGP HSE Cultural Ladder

The HSE Culture Ladder is often used to help identify Human Factor issues and determine what steps should be taken to move the group as a whole to a higher level.

One extreme (pathological) displays a failure and lack of willingness to recognise and/or address issues which may result in poor HSE performance.

At the other extreme (generative) safe working practices are viewed as a necessary and desirable part of any operation.

On any geophysical operation there may be a range of different behavioural levels between different groups and teams, i.e. different subcontractors & different position levels of the workforce.

The goal is to determine where each group sits on the ladder and take steps to improve HSE Culture to the next level for each.

Below is a guide on how to present HSE Cultural expectations at the crew level

EVERYONE

<i>Follow Rules</i>	<ul style="list-style-type: none"> • Learn relevant local standards, rules and procedures.
	<ul style="list-style-type: none"> • Strictly follow rules, and always uses the right procedure for the job.
	<ul style="list-style-type: none"> • Demonstrate excellent personal HSSE behavior.
	<ul style="list-style-type: none"> • Identify impractical rules and procedures, and promptly suggests improvements to Supervisor.
<i>Speak Up</i>	<ul style="list-style-type: none"> • Ask questions to gain clarification and understanding; listen to others' views and concerns.
	<ul style="list-style-type: none"> • Promptly report incidents, near-misses, unsafe conditions and error sources.
	<ul style="list-style-type: none"> • Express any HSSE concerns to Supervisor, including when unfit to work for any reason.
	<ul style="list-style-type: none"> • Challenge any unsafe behavior on the spot.
	<ul style="list-style-type: none"> • If in doubt, stop the job, and warns those who may be in danger
<i>Be Mindful</i>	<ul style="list-style-type: none"> • Stay vigilant; maintain continual awareness of hazards, surroundings and adjacent work.
	<ul style="list-style-type: none"> • Anticipate possible risks and problems; constantly asks 'what could go wrong'?
	<ul style="list-style-type: none"> • Take time to plan and organize necessary steps and resources to do the job safely, and keep the workplace tidy.
	<ul style="list-style-type: none"> • Avoid assumptions, verify and check understanding when unsure.
<i>Get Involved</i>	<ul style="list-style-type: none"> • Take care of other team members, and support team HSSE standards.
	<ul style="list-style-type: none"> • Contribute to team HSSE discussions and meetings.
	<ul style="list-style-type: none"> • Participate in local programs or initiatives to improve HSSE performance
	<ul style="list-style-type: none"> • Share own HSSE knowledge and learning with others.

SUPERVISORS

<i>Deliver HSE Excellence</i>	<ul style="list-style-type: none"> • Visit the worksite frequently to ensure compliance, and discusses HSSE issues with team.
	<ul style="list-style-type: none"> • Explains to team that HSSE excellence is expected of them.
	<ul style="list-style-type: none"> • Help team to resolve production/HSSE conflicts.
	<ul style="list-style-type: none"> • Able to challenge others, and accept challenges.
<i>Encourage the Team</i>	<ul style="list-style-type: none"> • Get to know the strengths and limitations of each team member.
	<ul style="list-style-type: none"> • Seek and listen to team HSSE suggestions, concerns and ideas.
	<ul style="list-style-type: none"> • Recognize and reward good individual and team HSSE performance, and deal firmly and fairly with poor performance.
	<ul style="list-style-type: none"> • Promptly act on HSSE concerns, seeking management support where necessary.
<i>Promote Risk Awareness</i>	<ul style="list-style-type: none"> • Take time to plan work with team, challenging any complacency about routine work.
	<ul style="list-style-type: none"> • Use their experience to help team to recognize and manage hazards and risks.
	<ul style="list-style-type: none"> • Encourage the team to be wary, and stop the job if they have HSSE concerns.
	<ul style="list-style-type: none"> • Carefully reassess hazards and risks when changes occur.
	<ul style="list-style-type: none"> • Consider other hazards, e.g. security, health, environment.
<i>Involve the Team</i>	<ul style="list-style-type: none"> • Work with the team to ensure they understand their HSSE goals and responsibilities.
	<ul style="list-style-type: none"> • Regularly initiate team discussions about HSSE performance, and shares lessons learned.
	<ul style="list-style-type: none"> • Support, coach and involve team members in implementing HSSE improvements.

For more information on Human Factors see <http://info.ogp.org.uk/hf/> & <http://www.ogp.org.uk/pubs/368.pdf>

It is increasingly clear that many workplace incidents are triggered by human behavior. Therefore, it is advisable that the HSE Management System be promoted by behavioral based HSE programs. Programs

which focus directly and proactively on unsafe behavior or unsafe acts can produce positive results for both the individual and the organization.

Behavioral Based HSE programs develop both **individual responsibility** and **shared vigilance**. Individuals learn to identify unsafe behaviors and apply these learning's to their own work. The identification of unsafe behaviors or unsafe acts can also be applied to a team, a crew or an organization so that through a shared perception of risk & shared experience the working environment is made safer.

A number of effective programs have been developed to help individuals and organizations deal with unsafe behavior. Some of these programs are described briefly below as a starting point in behavioral safety program.

Note: It is very important for management to understand that behavior

3.3 Work Observation Programs

Work Observation Programs rely on focused observation of people working, effective two-way communication and individual goal-setting for better performance. In these programs, line managers are encouraged to engage in positive HSE related interactions with workers.

Through observation and open, non-threatening questions, the observer examines any hazards present, what the outcomes might be, and how to reduce the risk. If unsafe behavior is observed, the observer seeks agreement & commitment from the person being observed to improve their behavior in the future. The observer will also normally try to commit to assisting in the improvement as well so the agreements are not just "one sided". A follow-up in the future is then also often required by the observer to ensure that the commitments were held.

3.4 Employee Led HSE Programs

Employee-led HSE programs aim to improve employee HSE behavior through peer observation, goal setting and feedback. This type of program is owned and managed by a team or crew, with support from local and senior management. The program develops employee ownership and involvement in HSE.

Once the employees establish the program, good and bad behaviors are defined based in part on a review of previous incidents. A checklist is established for clearly specified good and bad behaviors. Participants systematically monitor their colleagues' HSE behavior in a collaborative atmosphere.

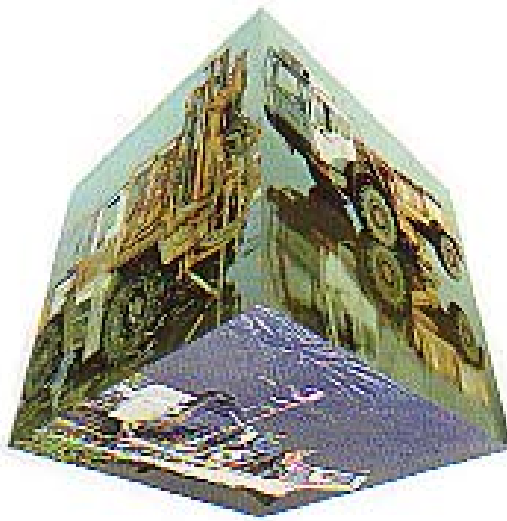
Both of these systems provide team members and line managers with a mechanism to stop any operation if they have HSE concerns. A "time out for safety or stop the job" is called and the team listens to the individual's concerns, discusses the job, and agrees on any actions that are necessary to ensure that the job is completed safely.

Workgroups set their own collective HSE improvement targets. Feedback is provided to the workgroup each week to allow them to track their progress against targets.

Behavioral HSE programs can lead to improved HSE performance; a better acceptance of responsibility for HSE and a better understanding of the relationship between behavior and incidents.

Note, however, that each of these programs requires thorough preparation and advance training.

4. Health, Hygiene & Injury Prevention



4 HEALTH, HYGIENE & INJURY PREVENTION

Employees need to be physically fit and healthy. A medical check may be required at pre-employment and on a scheduled basis. Personnel should advise the crew medical authority of any of the following:

- Conditions that may prevent them from completing the job in a safe manner.
- Any medication which their own doctor prescribes.
- Any other self-medication.

Prevailing conditions may require employees to participate in a supervised program of medication and inoculations against disease. Full participation is important to maintain health and fitness. Immunization & chemoprophylaxis programs should be explained to all crew members.

In close communities like camps and accommodation barges, simple infections can easily be spread from one person to others. Preventive measures, as well as easily effective treatment, are essential.

4.1 Health Risk Assessment (HRA)

It is important that assessments are made of potential factors that could adversely affect the health and welfare of the crew. The factors outlined below represent some of the more significant factors that should be considered in a project specific health risk assessment.

4.1.1 General Health Factors

- 1) Good health depends on a balance of work, rest, sensible and regular meals, adequate sleep and an avoidance of rich food, alcohol, tobacco and drugs.
- 2) Simple as well as serious infections can easily be spread from one person to another. Preventive measures, as well as effective treatment, are essential.
- 3) Prevalent patterns of local disease should be understood.
- 4) All personnel should maintain high standards of hygiene. Areas of concern should include:
 - a) Provisions for potable water
 - b) Sanitary bathing & toilet facilities
 - c) Sleeping quarters
 - d) Rubbish disposal (e.g., protection from pests, disease carrying / poisonous insects, & wild animals)
 - e) Kitchen facilities
- 5) Cuts and abrasions should be cleansed at once and given first aid treatment.
- 6) Many serious infections can be guarded against by inoculation and vaccination. These inoculations and vaccinations should be kept up to date as necessary to meet the requirements of the location or circumstances.

- 7) Prolonged exposure to oils may cause dermatitis and skin conditions. All traces of oil should be thoroughly washed from the skin and hydrocarbon solvents should be avoided. Oily work clothes should be laundered separately from other clothes and washed frequently. Oil-soaked rags should not be placed in pockets.
- 8) Exposure to or contact with toxic chemicals or other harmful substances should be reported immediately and the appropriate remedial action taken.
- 9) Some domestic cleaning substances, such as, ammonia, caustic soda and bleaching powders or liquids, can burn the skin. They may react dangerously with other substances, create poisonous gas and should not be mixed indiscriminately. Storage compatibility of these substances should always be considered.
- 10) High humidity and heat can lead to heat exhaustion and heat stroke, which may be fatal. When working in these conditions, it is advisable to drink adequate amounts of water daily, see Section Fluid Replacement. It is best to take small quantities at frequent intervals. Consult the crew medic for advice on electrolyte supplements. Occupied enclosed spaces should be well ventilated.
- 11) Exposure to the sun during the hottest part of the day should be avoided. When it is necessary to work in excessive sunlight, appropriate clothing offering protection to both head and body should be worn. Use a sun block or sunscreen cream or oil to protect parts of the body exposed to sun or drying winds.
- 12) Blood borne pathogens & sexually transmitted diseases should be considered a major and potentially fatal health problem. An awareness and education program, e.g. HIV awareness training for personnel is essential.
- 13) Surveillance programs should also be in place to monitor health factors.

4.1.2 Medical Care & Evacuation Plans

Adequate facilities, medical equipment, essential medicines, trained health care personnel should be provided based on the (HRA) Remote medical support should also be provided where required.

Appropriate medical evacuation plans to ensure evacuation of patient to quality medical care in emergency should also be in place

4.1.3 Ergonomics

Ergonomics is the science of designing user interaction with the equipment and workplace to suit the user. Proper ergonomic design is necessary to prevent repetitive strain injuries, which can develop over time and can lead to long-term disability.

4.1.3.1 Repetitive strain injury (RSI)

Repetitive strain injury (RSI) (also known as repetitive stress injury), is an injury of the musculoskeletal and nervous systems that may be caused by repetitive tasks, forceful exertions, vibrations, mechanical compression (pressing against hard surfaces), or sustained or awkward positions.

4.1.3.1.1 Computer use

Some computer users can suffer health problems as a result of their work but this can generally be avoided by good workplace and job design, and by training users. Health risks can include:

- Upper limb disorders (often inaccurately called repetitive strain injury or "RSI"), typically displayed as: Aches and pains in the hands, wrist, arm, neck or shoulder. In severe cases if no action is taken, these disorders can become persistent or even disabling.
- Stress: from pace of work and deadlines, or through frustration or anxiety when a computer system does not work well or the user does not feel competent to operate it.
- Eyestrain: Long spells of computer work can lead to tired eyes, discomfort or headaches (and can make users more aware of eye defects such as short sight).

An ergonomics assessment for all workstations should be conducted. This would include:

- Setting up equipment and workstations for the most comfortable working position, making full use of adjustable chairs, etc;
- Make sure there is enough work space to take whatever documents and other equipment are needed, in convenient positions;
- Arrange the screen, desk and lighting to avoid glare or bright reflections on the screen;
- Training users to avoid sitting in the same position for long periods. It is best to change posture as often as practicable, and take frequent breaks (either as rest breaks, or changes to a different kind of work).
- It is also important to train personnel to report feelings of discomfort related to the work environment. This should be reported to crew management and / or seek ergonomic advice.

4.2 Blood Borne Pathogens



HIV and all types of hepatitis are examples of blood borne pathogens. There may be times when due to an accident you may be asked to render first aid to the injured. Precautions should be taken to prevent coming into contact with any blood or body fluids. Universal precautions should also be taken when rendering first aid, being involved in hygiene related tasks (food and water handlers) and personnel in camp or vessel clinics to avoid any contamination.

- 1) All blood samples and body fluids should be handled and treated as if they are infectious.
- 2) If blood is drawn, provisions for a thorough cleansing of the site should be followed.
- 3) Personal Protective Equipment (PPE) can include latex gloves, fluid shield mask and a disposable apron, (to protect from contact with blood and body fluids).
- 4) Proper disposal methods for all contaminated materials should be enforced.

4.3 Substance Abuse

The use of alcohol, drugs and other personality modifying substances increases the risk of accidents. Employees should be aware of country, client and company policies on substance abuse. Illegal drugs and unauthorized consumption of alcohol are not allowed on any crew, and their use may be cause for dismissal.

Most facilities and companies do not allow alcohol under any circumstances, such as on crews with 24-hour operations or on board seismic vessels. It is the responsibility of the employee to abide by the policy of the client, company and crew on which they are working.

Prescription and over-the-counter medicines may also impair performance. Consult your physician and / or label instructions as to any work-related risk. Advise your crew medical authority of any medicines being used so proper safety precautions can be taken. The employee has the responsibility to report the use of all prescription or non-prescription medications prior to reporting for duty.

4.4 Hazards of Nature



A site-specific hazard analysis should be conducted at the planning stage of every job, and all hazards of nature should be included in the analysis. These hazards should be communicated to crew members during the site-specific orientation at the start of the job.

Each member of the crew should be instructed in the identification of hazards in nature such as plants, animals, snakes, insects and marine life. Included in the training should be an orientation on how to identify endangered

species, if any, in the area. Procedures should be developed to conduct the work taking into account these endangered species and any standoff distances imposed by regulatory agencies.



Prevention of injury when these hazards exist could involve the wearing of alternative or additional protective clothing other than that normally worn in a particular climatic environment. Changes in operating procedures may also be required.

4.5 Insect borne health hazards

There are many ways that insects can harm humans. They may transmit disease, cause severe allergic reactions & even cause death in some cases. The best control measure to protect oneself is to eliminate being bitten by insects.

4.5.1 Malaria



Mosquitos transmit malaria, encephalitis, yellow fever, west Nile virus, chikungunya, elephantiasis and dengue fever. Malaria, especially falciparum malaria, is a serious condition that can result in death within a few days if untreated. A Malaria Management Program should be in place where risks require such plans. Elements of the program should include, but not be limited to:

- Awareness Training for personnel;
- Bite prevention measures (i.e. sprays, netting, long sleeves and trousers);
- Chemoprophylaxis suitable for type of Malaria (e.g. Malarone, Doxycycline, Larium)
- Early diagnosis of symptoms and treatment.

How to Protect Yourself

If you are travelling to an area at risk of malaria, you need to protect yourself before you travel, while travelling, and when you return home.

Before travel

At least one month before you travel, speak with a travel clinic nurse or doctor. Ask about the risk of malaria in the area you plan to visit. If anti-malaria medications are recommended, you will be given a prescription. Most anti-malaria medication should be started at least one week before travelling. Make

sure you are aware of the possible side effects of the prescribed anti-malaria medication and that you know how to take the medication correctly and how long to take it.

Note: It is NOT recommended for preventive treatment to be administered to indigenous employees as a routine, as it may compromise their natural immunity.

While travelling

You can reduce your chance of malaria infection by doing the following:

Prevent mosquito bites.

- Mosquitoes are most active after sunset and before sunrise. Wear light colored clothing, long sleeve shirts, pants, and socks during these times. Treat clothing with an insect repellent prior to wearing them.
- When you are outside between dusk and dawn, use insect repellent on all exposed skin. The most effective repellents contain the ingredient DEET. *Caution - While "DEET" is the specified repellent for some areas, prolonged exposure may cause illness.*
- Burn pyrethroid mosquito/insect coils in the evening in well-ventilated areas.
- Sleep in places with screened windows and doors, or with air conditioning if possible.
- Sleep under a small-mesh mosquito net that has no holes and has been sprayed with an insecticide. Tuck the mosquito net under the mattress before it gets dark each day, or first thing in the morning, to prevent mosquitoes from getting into your bedding. The mosquito net is important if you cannot stop mosquitoes from entering your room.
- Apply insecticidal spray or fogging in the living & sleeping quarters.
- Use non-perfumed toiletries, antiperspirants & soaps. Mosquitoes are attracted to scented products.

When you return home

Anti-malaria medication does not prevent mosquito bites, or parasites from getting into your body. Once inside your blood, the parasites multiply. The medication stops the parasites from multiplying.

You should continue to take your anti-malaria medication as prescribed by your medical advisor or doctor after leaving the area at risk of malaria and returning home. If the medication is not taken for the recommended length of time, the parasites may start to multiply in your blood and make you sick.

Even when taking anti-malaria medication, there is a small chance of developing the illness, sometimes months later. If you develop a fever within a year of your return home, or other symptoms such as

persistent headaches, muscular aches and weakness, vomiting or diarrhea, speak with your doctor and tell him\her about your travels. Most companies will provide employees with a form that can be given to the doctor to aid in this process. Early diagnosis can prevent serious complications.

4.5.2 Ants, Wasps & Bee Stings

Ants, wasps and bees will sting sometimes causing a very severe allergic reaction (anaphylaxis) requiring immediate medical attention in some individuals.

Responding to bee & wasp stings

- If a bee sting victim has had any allergic reactions to bee stings in the past, always consider the possibility of a life-threatening allergic reaction. Safety first! Get away from the bees and call for immediate help.
- Remove any stingers immediately! Speed matters not the method.
- If a person knows they are allergic to bees they will usually carry an epinephrine auto-injector (EpiPen). This needs to be given straight away DO NOT WAIT FOR ALLERGIC SYMPTOMS TO APPEAR.
- If you are not familiar with allergy symptoms they include:
 - wheezing or difficulty with breathing
 - tightness in the throat or chest
 - swelling of the lips, tongue, or face
 - dizziness or fainting
 - nausea or vomiting
- If the person has an anaphylactic reaction call emergency services immediately if you have not already done so.
- Monitor DR-ABCD's - Give CPR if needed.

Notes: Take the victim to the emergency department if the victim was stung more than 10 times, or if there are bee stings inside the nose, mouth, or throat. Swelling from these stings can cause shortness of breath, even in non-allergic victims.

Allergic reactions can also flare from bites of body lice, and bites of chiggers, gnats (black flies, midges), sandflies, caterpillar stings and ticks. The puss caterpillar can give a severe sting that gives a human the symptoms of paralysis.

4.5.3 Poisonous Spiders & Scorpions

Poisonous spider bites & scorpion stings can be serious in some countries when working in remote areas. Scorpions sting with a poisoned hook on their tail, which is typically raised prior to an attack.

Avoiding scorpion stings

Scorpions are nocturnal animals and, therefore, typically only emerge at night. They often hide in dark cracks, under logs and vegetation but will enter accommodation if able.

- Accommodation should have a ledge that's at least 20cm high to prevent entry of scorpions.
- Apply insecticidal spray or fogging in the living & sleeping quarters.
- In areas with scorpions, it's also necessary to watch out for dark hiding places indoors: in cabinets, under beds and bed sheets, or in shoes (shake your shoes thoroughly before putting them on in the morning).
- Avoid walking through the bush wearing sandals or flip-flops
- In some countries, it's a popular sport to 'play' with scorpions – Avoid participating in this activity.

Danger signals and symptoms

Most scorpions are harmless to humans, although the sting is extremely painful and will require painkilling treatment.

The following may be observed in cases of moderate to more serious poisoning:

- malaise,
- sweating,
- heart palpitations,
- rise in blood pressure,
- salivation,
- nausea,
- vomiting and diarrhoea.

Hyper acute (typically allergic) reactions may also occur in the form of blurring of consciousness, unconsciousness, convulsions, fall in blood pressure, shock and consequently the threat of death.

Responding to scorpion stings

- In all cases of a scorpion sting activate the emergency response plan as quickly as possible.
- Pain at the site of the sting can sometimes be limited with an ice cube.
- Painkilling injections (morphine-based painkiller) may be required, and a doctor should therefore be consulted. In the case of more marked symptoms, treatment should be given as for snake bites, and the patient should receive medical treatment as quickly as possible.
- There's antiserum for scorpion venom. Treatment should be overseen by a doctor.

4.5.4 Spiders

Some spiders are poisonous, but only a few can prove dangerous to humans.

Avoiding spider bites

- In principle, spiders are more difficult to avoid than scorpions, particularly as they often stay indoors and like to hunt during the day. They will often, but far from always, prefer slightly damp places in semi-shade.
- Spider bites often occur when the insect is trapped in clothing. Keep clothing tucked in at all times if possible.
- Apply insecticidal spray or fogging in the living & sleeping quarters.

Symptoms and danger signals

- A stinging, slightly smarting pain is often felt at the site of the bite. The pain can sometimes be burning and violent. In some cases, there's no immediate pain, but instead it comes on after 30 to 60 minutes. Blistering, bleeding under the skin and a convulsive sensation in the muscles may be felt. Later, local tissue death may occur, but this depends on the venom concerned.
- General symptoms such as anxiety, a sensation of weakness, sweating, headache, dizziness, swelling around the eyes, skin rash, respiratory distress, nausea, salivation and vomiting are all possible.
- Difficulty in maintaining muscle control and convulsions, which in the worst case can affect the muscles involved in swallowing and breathing.
- Possibly allergic reactions with circulatory failure, shock and death.

First aid and treatment for spider bites

- In all cases of a scorpion sting activate the emergency response plan as quickly as possible.
- Ice cubes at the site of the bite may reduce the pain. In the case of bites from *Loxosceles* (the 'recluse' species), the ice should be packed to avoid causing further damage to tissue.

- There's antiserum for several spider venoms, and this treatment should be overseen by a doctor.
- In principle, bites from the truly poisonous spiders should be treated like snake bites, and a doctor should be consulted as soon as possible. The spider should be killed and taken along to the doctor for identification.

4.5.5 Other insect health related issues

4.5.5.1 House & Blow Flies

Flies are one of the most difficult insects to guard against on land seismic camps in some areas. Some flies mechanically carry germs by biting a diseased animal and then bite a healthy person thus contaminating them with disease. There are germs on garbage and human waste that a fly can crawl on it or walk on it and carry disease to humans such as tuberculosis, parasitic worms, yaws, trachome and cholera.

Blow flies are known as the blue bottle or the green bottle flies and carry much of the same disease-producing organisms as the house fly. The Dermatobia fly can infest man causing maggots to pop out of the eggs and burrow in the skin.

Prevention:

- Ensure camp waste is properly disposed of in accordance with the crew's waste management plans.
- Avoid the use of open waste pits
- All kitchen and dining area openings should be covered with insect screens. Screen doors should be sprung closed.
- Kitchen and dining areas should be equipped with UV electric bug zappers (insectocutors).
- Areas with a high concentration of flies can be equipped with fly paper or hanging "sticky" fly paper if possible. (these should be changed out regularly and not hung over food preparation areas or dining areas)
- In "fly" camps where such controls are not practical, every possible measure should be taken to protect food from insects.
- Adequately contained (screened) food preparation areas
- Use insecticides at least 30 minutes before serving food to avoid contamination. Cover all utensils and dishes before using insecticide.
- Kitchen and dining area should be regularly treated by insecticide /pesticides and this included in procedures.

- If possible the entire camp should have scheduled fumigation.
- All pest controls should be included in the kitchen/camp inspection checklists

4.5.5.2 Ticks

Ticks are actually a type of mite but can cause ailments such as Rocky Mountain spotted fever and Lyme disease, but the negative effects of their bites can take time to appear.

Preventing Tick Bites:

- Use an insect repellent that is 20% to 30% DEET. *Caution - While "DEET" is the specified repellent for some areas, prolonged exposure may cause illness.*
- Treat clothing with a Permethrin spray as a further deterrent to ticks.
- Wear long pants and long sleeves. The clothing does not have to be heavy, but the length will provide an additional way of keeping ticks from getting to your skin.
- Tuck your pant legs into your socks. This creates an additional barrier that makes it harder for ticks to get in.
- When in thick wooded areas or areas with tall grass be aware of the presence of ticks. Check your clothing frequently.
- Check your body for ticks after work is completed.

How to remove a tick

The proper way to remove a tick is to use a set of fine tweezers and grip the tick as close to the skin as is possible. Do not use a smoldering match or cigarette, nail polish, petroleum jelly (e.g., Vaseline), liquid soap, or kerosene because they may irritate the tick and cause it to behave like a syringe, injecting bodily fluids into the wound.

The proper technique for tick removal includes the following:

- Use fine tweezers to grasp the tick as close to the skin surface as possible.
- Pull backwards gently but firmly, using an even, steady pressure. Do not jerk or twist.
- Do not squeeze, crush, or puncture the body of the tick, since its bodily fluids may contain infection-causing organisms.
- After removing the tick, wash the skin and hands thoroughly with soap and water.
- If any mouth parts of the tick remain in the skin, these should be left alone; they will be expelled on their own. Attempts to remove these parts may result in significant skin trauma
- Report the bite to the crew medic & ensure that the date of the bite is recorded; some symptoms may take up to a month to develop.
- If you eventually develop a rash at the site of the bite, experience chills, headache or fever, report this immediately and see a doctor. You should also consult a doctor should you experience extreme fatigue, muscle weakness or difficulty walking.

4.6 Heat Stress

The sun is a natural hazard, and the use of long trousers, long-sleeve shirts, head protection (wide-brimmed hat), sunglasses and sunscreen can help alleviate the effects of the sun.

4.6.1 Causal Factors

Age, weight, degree of physical fitness, degree of acclimatization, metabolism, use of alcohol or drugs and a variety of medical conditions such as hypertension all affect a person's sensitivity to heat. However, even the type of clothing worn should be considered. Prior heat stress predisposes an individual to additional stress.

It is difficult to predict just who will be affected and when, because individual susceptibility varies. In addition, environmental factors include more than the ambient air temperature. Radiant heat, air movement, conduction and relative humidity all affect an individual's response to heat.

4.6.2 Heat Rashes

Heat rashes are the most common problem in hot work environments. Prickly heat is manifested as red papules and usually appears in areas where the clothing is restrictive. As sweating increases, these papules give rise to a prickly sensation. Prickly heat occurs in skin that is persistently wetted by un-evaporated sweat and heat rash papules may become infected if they are not treated. In most cases, heat rashes will disappear when the affected individual returns to a cool environment.

4.6.3 Heat Cramps

Performing hard physical labor in a hot environment may cause heat cramps. These cramps have been attributed to an electrolyte imbalance caused by sweating. It is important to understand that cramps can be caused by either too much or too little salt in the body.

4.6.4 Heat Fatigue

The signs and symptoms of heat fatigue include impaired performance of skilled sensorimotor, mental, or vigilance jobs. There is no treatment for heat fatigue except to remove the heat stress before a more serious heat-related condition develops.

4.6.5 Heat Collapse ("Fainting")

In heat collapse, the brain does not receive enough oxygen because blood has pooled in the body's extremities. As a result, the exposed individual may lose consciousness. This reaction is similar to that of heat exhaustion but does not affect the body's heat balance. However, the onset of heat collapse is rapid and unpredictable. To prevent heat collapse, the worker should gradually become acclimatized to the hot work environment.

4.6.6 Heat Exhaustion

The signs and symptoms of heat exhaustion are cool, moist, pale, or flushed skin, headache, nausea, vertigo, weakness, thirst and giddiness. Fortunately, this condition responds readily to prompt treatment.

4.6.7 Heat Stroke

Heat stroke occurs when the body's system of temperature regulation fails and body temperature rises to critical levels. This condition is caused by a combination of highly variable factors and its occurrence is difficult to predict. The symptoms of heat stroke include red, hot, dry skin; changes in consciousness; rapid, weak pulse; rapid, shallow breathing.

Heat stroke if untreated can result in death.

4.6.8 Treatment of Heat Stress

It is critical that you recognize heat-related illness in its early stages, and to reverse it.

- Get the victim out of the heat.
- Loosen any tight clothing.
- Apply cool, wet cloths, such as towels or sheets.
- If the victim is conscious, give cool water to drink as described under Fluid Replacement (below). Refusing water, vomiting and changes in consciousness mean that the victim's condition is getting worse.
- Initiate the crew's Emergency Response Plan (ERP) immediately.

If the victim vomits, stop giving fluids and position the victim on the side. Watch for signs of breathing problems. Keep the victim lying down and continue to cool the body any way you can. If you have ice packs or cold packs, place them on each of the victim's wrists and ankles, on the groin, in each armpit and on the neck to cool the large blood vessels. Do not apply rubbing (isopropyl) alcohol.

4.6.9 Controls

Ventilation, air cooling, fans, shielding and insulation are the five major types of engineering controls used to reduce heat stress in hot work environments.

The following administrative controls can be used to reduce heat stress:

- 1) Reduce the physical demands of work, e.g., excessive lifting or digging with heavy objects.
- 2) Use only workers who are acclimatized to the conditions.
- 3) Provide recovery areas, e.g., a shaded, cooler area. In some areas it may be possible to provide air-conditioned enclosures and rooms.
- 4) Use shifts, e.g., early morning, cool part of the day. Use intermittent rest periods with water breaks.
- 5) Limit the number of workers present, especially in confined or enclosed spaces.

4.6.10 Fluid Replacement

Cool, 50-60°F (10-16°C), water or any cool liquid (except alcoholic drinks) should be made available to workers to encourage them to drink small amounts frequently, e.g., one cup every 20 minutes. Ample supplies of fluids should be placed close to the work area. Although some commercial replacement drinks contain salt, this is not necessary for acclimatized individuals because most people add enough salt to their summer diets.

Commercial “thirst” drinks may satisfy your thirst before your body is properly rehydrated.

4.6.10.1 Dehydration

In the urine color chart below for dehydration, level 1 and level 2 indicate normal urine colors. Level 3 urine color meaning indicates dehydration to some extent, whereas 4 and 5 point towards severe dehydration.

Dehydration results in impaired performance of an individual. If you notice dark urine along with the symptoms of dehydration you need to stop all physical activity. You should loosen your clothes and sit down. Drink water, but not in gulps. Instead sip water slowly. If you gulp water down, it will lead to severe nausea and even vomiting. Sipping will help your body replenish water and overcome dehydration. If one suffers from vomiting, confusion, agitation, convulsions, high body temperature due to dehydration, call for medical help immediately. The person needs to be laid down on a flat surface and loosen all clothing. Give him sips of water if the person is conscious. You can pour cold water over the person or apply ice on their skin to cool them.





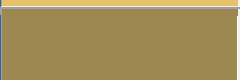
Urine Color Chart	Dehydration Level	Interpretation
	Level 1	Clear urine means that you are hydrated. You need to continue drinking water as normal.
	Level 2	This means you are fine and maybe you need to drink a little more water.
	Level 3	This is a mild dehydration symptom. You need to drink ½ a bottle of water or about ¼ liters of water in an hour especially if you are outside or sweating.
	Level 4	This is a severe dehydration symptom . You need to drink about ½ liter bottle of water immediately.
	Level 5	This is the most severe sign of dehydration . You should be drinking ½ liter water and seek medical help without delay.

Table 1 - Urine Color Chart for Hydration

4.7 Cold Conditions

One of the most important lessons to be learned is that, in all cases, extreme cold dictates that additional time is required to complete a job assignment. Such additional time should always be allowed in the planning phase.

Climatic conditions in arctic or cold regions are important and must not be ignored. The most persistent and most dangerous is that of extremely low temperatures or low wind-chill.

The adverse effect of cold on man is to produce a condition called hypothermia, which is the lowering of body temperature due to loss of heat at a rate faster than the body can produce it. Normally, body temperature is 37°C (98.6°F). When the body temperature falls below 34°C, (93°F), the patient may become disoriented and lapse into a coma. Heart failure and death can result if body temperature falls below 31 to 32°C (88 to 90°F).

Frostbite (a cold injury caused by freezing of the body tissues or body part) can occur without hypothermia when extremities do not receive sufficient heat from the central body due to restricted blood circulation or inadequate insulation. Both conditions (frostbite and hypothermia) may occur at the same time if the body is exposed to subfreezing temperatures. Whenever a patient is treated to thaw any portion of the body, care must be exercised to prevent the possibility of refreezing.

Hypothermia can occur from exposure to temperatures above freezing in instances such as immersion in cold water, exposure to wind (wind chill), physical exhaustion and insufficient food.

Drinking alcohol in a cold environment is extremely dangerous. It causes dilation of the blood vessels, permitting a rapid loss of body heat and thus, increasing the risk of hypothermia.

Related cold injuries include trench foot (a thermal injury resulting from exposure to cold, short of freezing, in a damp or wet environment), immersion foot (an injury resembling trench foot and caused by prolonged immersion of the extremities in water) and the effect of total immersion in near freezing water. In this last case, immersion for only a few minutes will cause total body cooling with a marked drop in inner body temperatures. Exposure to severe dry cold while inadequately dressed will produce the same effect.

In general, the length of time that a person may be exposed to cold, without danger of injury, varies directly with the temperature, wind velocity and protective clothing. The lower the temperature and the stronger the wind, the sooner injury will occur.

4.7.1 Wind Chill

The primary problem in cold weather is exposure to lower temperatures ranging from 5 °C (41°F) above zero to 45°C (50°F) below. In calm air, 4°C (39°F) above zero might not seem very cold, but in a relatively gentle 16 km (10 mph) wind, the equivalent chill temperature drops below freezing.

Maximum wind speed occurs during periods of seasonal transition and changing temperatures. Winds above 160 km/hr (100 miles/hr) during such periods have been recorded. For the full impact of wind chill, you can note on the wind-chill chart that a 16 km (10 Mph) wind with a -21°C (- 6°F) calm air temperature produces an equivalent chill of -32°C (-25°F), at which exposed flesh may freeze within one minute.



NWS Windchill Chart

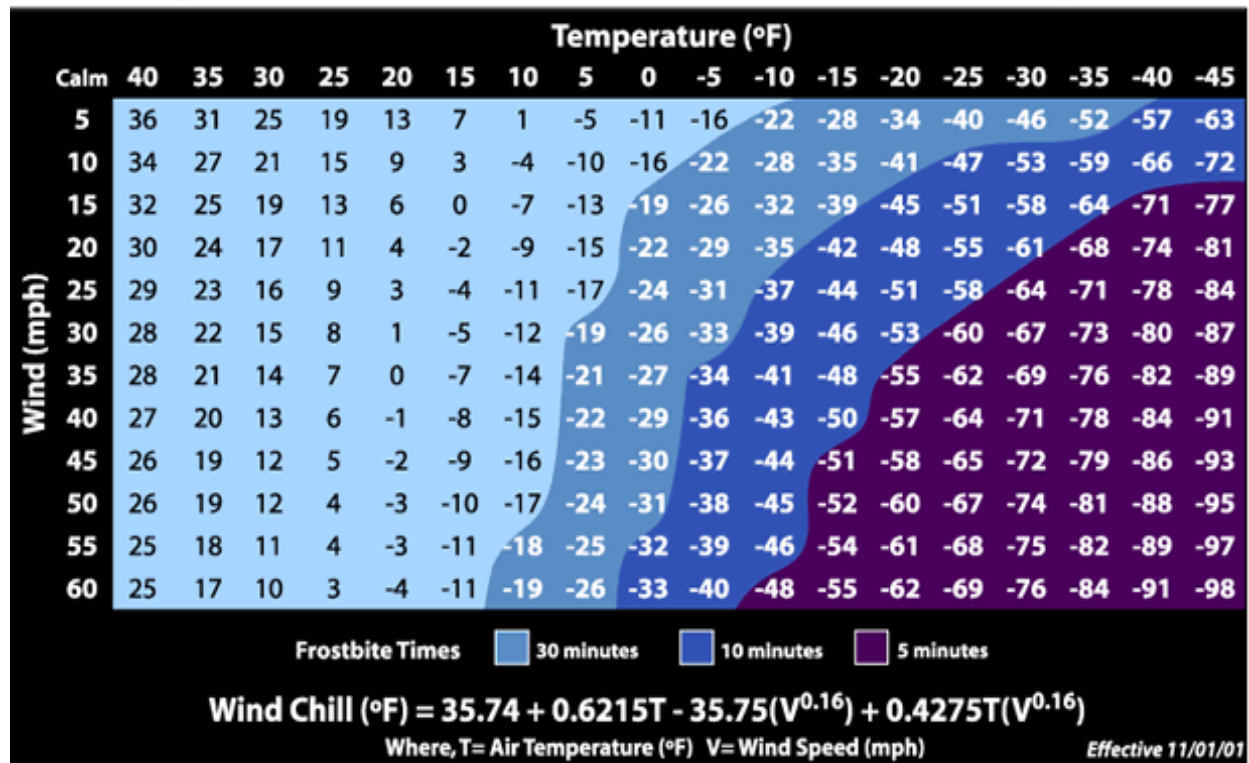


Figure 4 – US NWS Wind Chill Chart (Imperial)

Metric Wind Chill Chart														
		Temperature (degrees Celsius)												
		10 °C	5 °C	0 °C	-5 °C	-10 °C	-15 °C	-20 °C	-25 °C	-30 °C	-35 °C	-40 °C	-45 °C	-50 °C
Wind speed (kph)	10 km/h	8.6	2.7	-3.3	-9.3	-15.3	-21.1	-27.2	-33.2	-39.2	-45.1	-51.1	-57.1	-63.0
	15 km/h	7.9	1.7	-4.4	-10.6	-16.7	-22.9	-29.1	-35.2	-41.4	-47.6	-53.7	-59.9	-66.1
	20 km/h	7.4	1.1	-5.2	-11.6	-17.9	-24.2	-30.5	-36.8	-43.1	-49.4	-55.7	-62.0	-68.3
	25 km/h	6.9	0.5	-5.9	-12.3	-18.8	-25.2	-31.6	-38.0	-44.5	-50.9	-57.3	-63.7	-70.2
	30 km/h	6.6	0.1	-6.5	-13.0	-19.5	-26.0	-32.6	-39.1	-45.6	-52.1	-58.7	-65.2	-71.7
	35 km/h	6.3	-0.4	-7.0	-13.6	-20.2	-26.8	-33.4	-40.0	-46.6	-53.2	-59.8	-66.4	-73.1
	40 km/h	6.0	-0.7	-7.4	-14.1	-20.8	-27.4	-34.1	-40.8	-47.5	-54.2	-60.9	-67.6	-74.2
	45 km/h	5.7	-1.0	-7.8	-14.5	-21.3	-28.0	-34.8	-41.5	-48.3	-55.1	-61.8	-68.6	-75.3
	50 km/h	5.5	-1.3	-8.1	-15.0	-21.8	-28.6	-35.4	-42.2	-49.0	-55.8	-62.7	-69.5	-76.3
	55 km/h	5.3	-1.6	-8.5	-15.3	-22.2	-29.1	-36.0	-42.8	-49.7	-56.6	-63.4	-70.3	-77.2

	60 km/h	5.1	-1.8	-8.8	-15.7	-22.6	-29.5	-36.5	-43.4	-50.3	-57.2	-64.2	-71.1	-78.0
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Figure 5 - Metric Wind Chill Chart

4.7.2 Frostbite

Frostbite is characterized by:

- 1) Sensation of coldness followed by numbness.
- 2) Tingling, stinging, aching, or a cramping pain.
- 3) Initial redness followed by pale gray or waxy skin appearance.

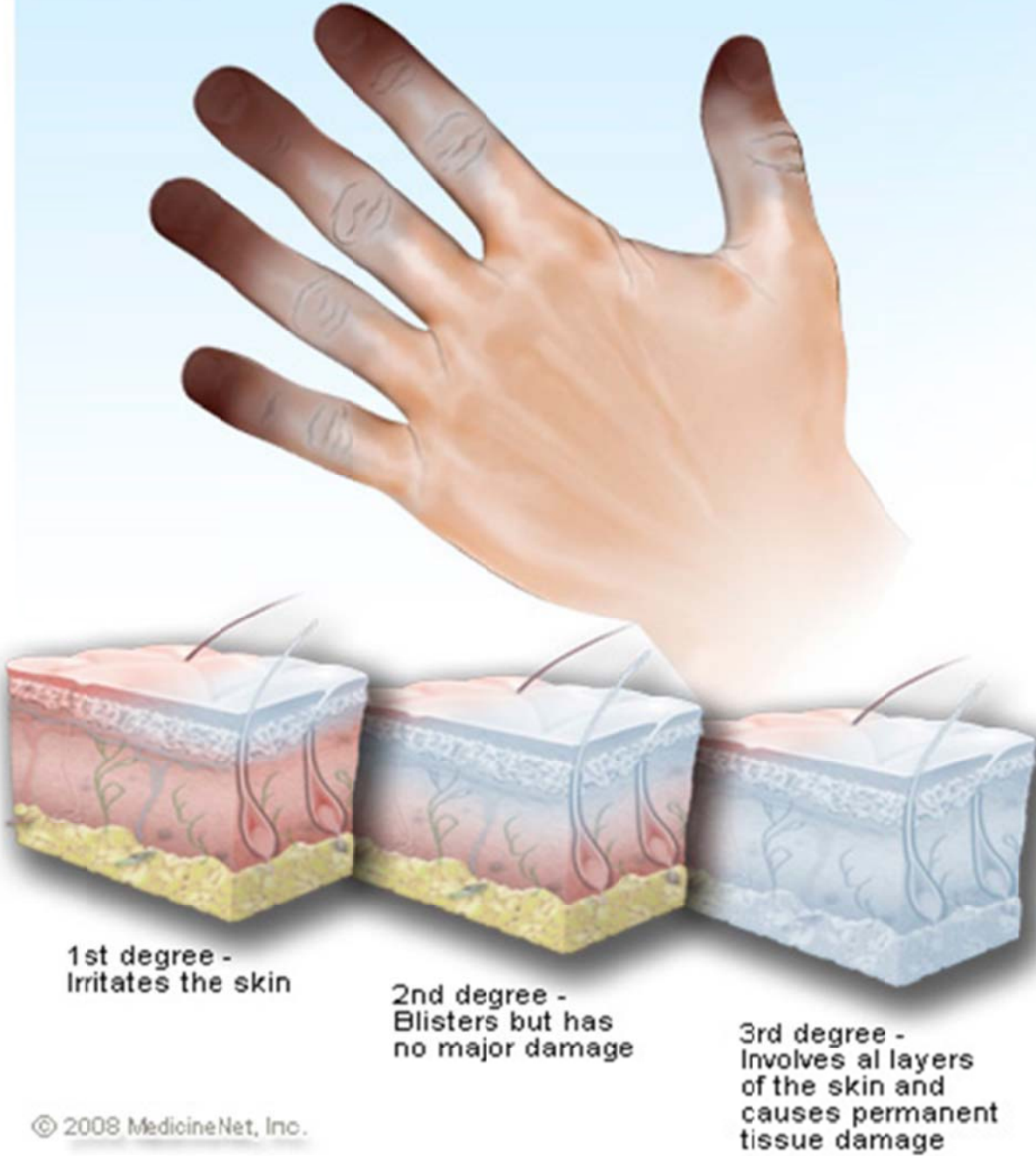
To review preventative measures:

- 1) Wear sufficient clothing, including face, ear, eye, head, nose, hand, and foot protection.
- 2) Avoid tight clothing and tight hand and footwear that could interfere with blood circulation.
- 3) Exercise face, fingers and toes. Massage the ears to keep them warm and to detect any numb or hard areas.
- 4) Use the buddy system to detect signs of frostbite.

Frostbite may be either superficial (involving only the skin) or deep (extending below the skin). If exposure time was very short, the frostbite is probably superficial. Otherwise, assume that the injury is deep and, therefore, serious. Treatment for superficial frostbite in the field:

- 1) Cover cheeks with warm hands until pain returns.
- 2) Place uncovered frostbitten fingers under the opposing armpit next to the skin.
- 3) Never warm by massage, exposure to open fire, cold water soaks, or rubbing with snow.
- 4) Be prepared for pain when thawing occurs.
- 5) Notify competent medical authority.

Frostbite



Treatment for deep frostbite:

- 1) Do not treat deep frostbite in the field. Get the patient wrapped up and to a hospital or aid station by the fastest means possible.

- 2) Protect the frozen part from additional cold injury but do not try to thaw.

4.7.3 Trench Foot

Is an injury resulting from exposure to cold, short of freezing, in a damp or wet environment. It is said to occur in the temperature range between zero and 10°C (32 and 50°F). It is almost identical to gradual frostbite since the primary causes are the same except for differences in the degree of cold.

Causes include:

- 1) Immobility of the limbs (legs and feet down as in sitting or standing).
- 2) Insufficient clothing.
- 3) Lack of blood circulation to the body by boots, socks and other garments being too tight.

To prevent:

- 1) Keep feet dry by wearing waterproof footwear including wool socks. Exercise the feet to keep them warm.
- 2) Change into clean, dry socks and boots at every opportunity, or at least daily.
- 3) Dry the feet as soon as possible after getting them wet. They may be warmed with the hands. Foot powder should be applied and dry socks put on.
- 4) If wearing wet boots and socks is unavoidable, the feet should be exercised continually by wiggling the toes and bending the ankles.
- 5) Never wear tight boots.

Treatment:

- 1) Feet should be handled gently. They should not be rubbed or massaged.
- 2) Clean feet carefully with plain white soap and water, dry, elevate and expose to the air.
- 3) While it is desirable to warm the patient, the feet should be kept at room temperature 20°C (70°F).
- 4) After first aid, treatment by qualified medical personnel is essential. The patient should be carried and not permitted to walk on injured feet.

4.7.3.1 Personal Protection

A person can be protected from cold by the following means:

- 1) The knowledgeable use of specialized cold weather clothing.
- 2) The regular and frequent consumption of essential foods and liquids.
- 3) Provision for adequate shelter.
- 4) Auxiliary body heating and cooling devices should be included for prevention and first aid.

The principles governing clothing are:

- 1) Use only clothing designed for arctic or extreme cold conditions. Consider new fabrics designed for extreme weather/cold conditions. Several layers, instead of very thick garments, are preferable.
- 2) Take maximum advantage of the protection this clothing affords.
- 3) Dress consistent with the weather. Remember: it is easier to remove excess clothing than not have sufficient clothing.
- 4) Have available all of the items needed in the event a severe change in weather occurs. Clothing for both cold-wet (moderately cold weather $\pm 10^{\circ}\text{C}$ (14°F) and cold-dry (temperatures below 14°F) should be at hand.
- 5) The efficient use of clothing requires observation of the following:
 - a) Keep clothing Clean
 - b) Avoid Overheating.
 - c) Wear Loose clothing and in layers.
 - d) Keep Dry

Remember **C-O-L-D** to keep warm in winter.

- 6) Clean clothes not only provide for sanitation and comfort but, more importantly, they provide efficient insulation.
- 7) When the temperature rises:
 - a) If indoors, wear a minimum of clothing and don't overheat the shelter.
 - b) If outdoors or when hard work is being performed, adjust clothing accordingly
 - c) It is better to be a little cold than too warm in order to promote maximum effectiveness of body heat production.
- 8) During severe wind-chill conditions, wear a cold-weather mask or wool scarf. Remove face protectors at intervals in order to check for frostbite.
- 9) **C-O-L-D** applies to hand and footwear, just as it does to clothes.
- 10) Insulated footwear with wool socks, not cotton, are preferred to prevent frostbite.
- 11) Never touch cold metal with bare hands.

4.7.3.2 Foods and Liquids

Balanced meals and adequate liquid intake are essential to body heat production and the prevention of dehydration.

- 1) Eat a nutritional, balanced diet for essential body heat production.

- 2) While in base camp, eat regular balanced meals as instructed, particularly in the morning and evening before and after a hard day's work. A complex carbohydrate diet is preferable to a high protein, high sugar, or high fat diet.
- 3) Maintain normal liquid intake.
 - a) Dehydration (loss or deprivation of water) is as prevalent in cold regions as it is in hot-dry areas.
 - b) Dehydration should be avoided at all costs by consuming sufficient additional liquids to offset losses caused by additional exertion in order to perform all tasks in cold weather.
 - c) Warm liquids (hot soup or tea) are preferable since they do not have to be warmed by the body after consumption.
 - d) Eat cold food only as a matter of necessity. Avoid eating snow if at all possible. It will deplete body heat.

4.7.3.3 Personal Hygiene

- 1) Bathe as frequently as conditions permit, daily is normal.
- 2) Keep hair cut and beard shaved or clipped close. Long hair or a beard adds very little insulation value. In the open, a beard serves as a base for ice build-up and will mask the onset of frostbite.
- 3) Since shaving with a blade and soap removes protective face oils, it should be done several hours before exposure to cold in order to allow for replacement of natural oils that reduce the danger of frostbite. Shave at night after work rather than in the morning.
- 4) Electric razors are preferable since they do not remove protective oils.
- 5) Brush your teeth daily.
- 6) Take advantage of toilet facilities in base camp before you leave for the field.

4.7.3.4 Adequate Shelter

- 1) Take full advantage of the base camp shelter in order to avoid unnecessary exposure.
- 2) Where necessary improvise shelter in accordance with techniques covered in your training programs.
- 3) You cannot stay in the open for long periods unless you are moving. You should know how to protect yourself from the effects of cold weather.



Correct Lifting Position

Wrong Lifting Position (Puts strain on the lower back)



Wrong: Never Twist (Puts strain on the lower back)

Always Position the Load and Avoid Overloading

4.8 Manual Lifting

Most back injuries are caused by negligence or violation of basic safe lifting rules. You can prevent a painful back injury if you first assume a squatting position. Keep the object close to your body and raise the object by straightening your legs. Get help when needed.

To minimize the likelihood of a back injury when lifting materials, the following steps should be taken:



1. Plan ahead before lifting.

Know what you're doing and where you're going to help prevent you from making awkward movements or turning awkwardly while holding heavy object. Assess the weight before lifting. Make sure you have a clear path. Take advantage of skids, hoist, bars, jacks, blocking, rollers or hand trucks when moving heavy material. If the object is too heavy to lift with one person, get help. When lifting together, plan to pick up or lay down the object on a given signal and make sure both of you agree on the plan.

2. Stand Close to the Load:

Stand close to the load with your feet spread apart about shoulder width. Place one foot slightly in front of the other for balance.



3. Bend at the Knees:

Squat down bending at the knees (not your waist). Tuck your chin while keeping your back as vertical as possible.



4. Control the Load:

Get a firm grasp of the object before beginning the lift.



5. Lift with Your Legs:

Begin slowly lifting with your LEGS by straightening them. Never twist your body during this step. Be sure your footing is secure. "Look up, stand up", straightens the back naturally; looking down at the load keeps the back bent. Keep your body erect. Always lift with your legs and not your back.



6. Keep Load Close to Body:

Once the lift is complete, keep the object as close to the body as possible. As the load's center of gravity moves away from the body, there is a dramatic increase in stress to the lumbar region of the back.

Never pick up or put down an object while you are in a twisted position. If you must turn while carrying the load, turn using your feet-not your torso. Keep your eyes up. Looking slightly upwards will help you maintain a better position of the spine.

Use the correct lifting procedures for lightweight objects as you would for heavy weight. Failure to do so may result in injury.

Dos and Don'ts of Lifting

Always use both hands when lifting and lift slowly and deliberately. The ideal situation is to have someone or something to help you when lifting, but if that's not possible, follow all the above listed guidelines to minimize your risk of injury.

Following is a review list of dos and don'ts when bending and lifting:

Dos

- Do place your feet and knees at least shoulder width apart or front to back in a wide-step position. This will help you bend at the hips, keeping your back relatively straight and stress free.
- Do lean over or squat with the chest and buttocks sticking out. If you do this correctly, your back will be flat and your neck will balance in a relaxed neutral position.
- Do take weight off one or both arms if possible. When you squat down or push back up, use your hand or elbow as support on your thigh or any available structure. This takes some of the compression and strain off of the lower back.
- Do balance your load on either side if possible, or switch sides so that both sides are equally stressed.
- Do level the pelvis or tuck in your buttocks and suck in your abdomen, when reaching or lifting overhead. Keep your chest up and use a step stool to keep the low back and neck in neutral alignment.
- Do walk around and use backward-bending and/or stomach-lying positions before or after bending or heavy lifting, especially if you've been sitting for a while.
- Do level the pelvis or tuck in your buttocks and suck in your abdomen, when reaching or lifting overhead. Keep your chest up and use a step stool to keep the low back and neck in neutral alignment.

Don'ts

- Don't lift things when your feet are too close together. If your feet are closer than shoulder width you'll have poor leverage, you'll be unstable, and you'll have a tendency to round your back.

- Don't lift with your knees and hips straight and your lower back rounded. This is the most common and stressful bad lifting move. Twisting the trunk during this bad move compounds the problem.
- Don't tense and arch the neck when lifting. This crams your neck joints together and causes pain especially if maintained for a long period of time.
- Don't twist or turn when carrying a heavy load.
- Don't lift and/or carry an unbalanced load.
- Don't lift and bend too much in a short period of time.
- Don't lift objects that are too heavy for you.
- Don't mistakenly believe that a lifting belt will increase your maximum lifting potential.
- Don't lift heavy objects directly following a sustained period of sitting, especially if you have been slouching.
- Don't lift things overhead with your neck and back arched, if possible.

4.9 Fatigue

It is well accepted that fatigue will adversely affect your judgment in even simple and familiar activities. To keep going when tired is not a sign of strength but potentially a danger to yourself and others. Sometimes it is difficult to recognize fatigue in oneself and it is important that management practices and systems control activities so as to safeguard against it happening.

The Law in some countries mandates the number of hours, which a person may work without a break. Careful consideration should be made of all applicable regulations concerning work hours and rest periods.

Haste, stress and fatigue are often contributing factors to many incidents. In the absence of regulatory requirements, appropriate work and rest schedules should be considered.

4.10 Personal Protective Equipment & Clothing (PPE/PPC)

It is the direct responsibility of every employee to wear and use the protective clothing and equipment provided. Each employee is responsible for ensuring such equipment is kept in a good state of repair.

- 1) Appropriate personnel protective clothing and equipment for the area and work activity should be worn that meets the required standards for that region (i.e. ANSI / EN / CSA). A risk assessment should determine the appropriate type of PPE to be worn and when.
- 2) Do not wear loose clothing near moving machinery such as engines, vibrators, or drills. Tuck shirts in, fasten cuffs and tuck and restrain long hair under appropriate headgear. Although short sleeved shirts and shorts may be permitted in some climates for certain activities, overalls, long sleeved shirts & pants provide better protection than short sleeved clothing and should be the first choice. Shirts, pants and coveralls should not be ripped or torn.
- 3) Suitable gloves should be worn for specified jobs.

- 4) The need for hard hats and protective footwear should be based on the risk assessments completed for the work being done and worn as required by company policy, crew procedures or by posted instructions.
- 5) When selecting eye and combined eye and face protectors, careful consideration should be given to the kind and degree of the hazard and the degree of protection and comfort afforded. The main causes of eye injuries are:
 - a) Cutting, grinding, impact tools.
 - b) Infrared rays (e.g., from gas welding).
 - c) Ultraviolet rays (e.g., from electric welding).
 - d) Exposure to chemicals (e.g., from battery acid).
 - e) Exposure to particles and foreign bodies (e.g., from helicopters, wind, air system blast)
 - f) Strong sunlight or snow blindness.
 - g) Battery explosions or splashes.

Ordinary prescription glasses do not afford protection. Eye protection is available in a wide variety of styles and applications. Prescription eye protection is also available and should be provided by the employer. Individuals requiring such prescription eyewear should consult their supervisor for advice on obtaining the correct equipment.

- 6) All persons exposed to high levels of noise (identified during a noise risk assessment) should wear hearing protection suitable for the particular circumstances. If you have to raise your voice to be heard, you are probably in an area requiring hearing protection.
- 7) Long-term exposure to high noise levels may cause long-term and permanent hearing loss. Personnel who are exposed to high noise levels should be tested (pre-employment & periodically thereafter) for hearing loss.
- 8) A noise risk assessment should be made of any questionable area and ear protection zones marked / signposted.

4.10.1 Noise Exposure Limits



Loud noise at work can damage your hearing. There are different regulations depending on which country you are working in. Noise regulations require a company to prevent or reduce risks to health and safety from exposure to noise at work.

The regulations may require a company to:

- assess the risks to the employees from noise at work;
- take action to reduce the noise exposure that produces those risks;
- provide employees with hearing protection if it is not possible to reduce the noise exposure enough by using other methods;
- make sure the legal limits on noise exposure are not exceeded;
- provide the employees with information, instruction and training;
- carry out health surveillance where there is a risk to health.

The table below show examples of what exposure limits are permitted.

Noise Exposure Limits = 85 dB(A)		
3 dB(A) Exchange Rate	Maximum Permitted Daily Duration (hours)	5 dB(A) Exchange Rate
Allowable Level dB(A)		Allowable Level dB(A)
85	8	85
88	4	90
91	2	95
94	1	100
97	0.5	105
100	0.25	110

4.11 Personal Flotation Devices (PFDs)

Personal Flotation Devices (PFD) are required to be worn by all personnel, (regardless of whether they can swim), who operating in, over, through or on water, where there is a danger of drowning.

4.11.1 Life Jackets/Work Vests

There is an extensive choice of life-saving equipment available, and the first decision is whether to use a work vest or a life jacket for a particular type of operation.

The main difference is one of degree rather than function. Work vests will, at their best, assist a conscious person to stay afloat in the water. A life jacket is designed to turn an unconscious or exhausted person face upward, with the head held clear of the water.

Points worthy of note during any assessment of personal flotation devices (PFDs) or work vests are as follows:

Personal Flotation Devices (PFDs) are required by all persons, regardless of swimming ability, operating in, over, through, or on water where there is a danger of drowning. PFDs should be worn correctly and adjusted securely at all times when in use. Particular attention is drawn to point 3 below. A loose PFD will not operate as designed.

- 1) Equipment should be approved by a recognized independent body.
- 2) In order to maintain a 60° face-up position, backward from the vertical position, it is necessary to have closed-cell foam padding all the way down the front and half way or less down the back.

Consideration should also be given to wear and tear that causes foam to shift about, affecting the distribution of buoyancy.

- 3) If zippers are used on the devices, they should be of good quality, preferably with tie straps at the top and bottom.
- 4) A belt or strap should be provided to assist in retrieving the victim from the water.
- 5) Consideration should be given to comfort and vision. Those devices without crotch straps can result in the victim dropping down inside the device until the shoulder seams are on a level with the top of the head. A flotation collar that gives additional head support is also preferable.
- 6) A whistle should be provided on the Type I PFD that is housed in a loop or small pocket as well as a light that is activated on immersion in water. The color should be orange or yellow for good visibility and reflective strips on the shoulders or collar are an added advantage.

The three main types of life jackets are:

- 1) An inherently buoyant life jacket, well-padded with closed-cell foam.
- 2) Manual gas-inflatable life jackets with a pull-tag to activate the carbon-dioxide cylinder with oral inflation tube.
- 3) Automatic gas inflatable life jackets in which the carbon-dioxide cylinder is activated when immersed in water, with both oral inflation and manual pull-tag override.

Cold water can be your worst enemy because sudden immersion induces short, gasping breaths and panic. A novice will flounder, finding it difficult to grab at a pull-tag or inflate a jacket orally. This is another argument in favor of inherent buoyancy or automatic gas inflation.

Even if a life jacket is doing its job, in shallow sea conditions, near sea walls, the sides of boats, or in estuaries, waves breaking over the head may cause drowning. Splashguards are not a standard item but a number of manufacturers can supply them and they should be considered.

Life jackets should be capable of being donned and adjusted within 30 seconds. They should have a conspicuous, centrally positioned lifting bracket (a strong webbed loop with which to pull the wearer from the water). They should turn an exhausted or unconscious person face upward (within five seconds with inherent buoyancy and ten seconds with auto or manual gas inflation) and hold the body inclined backward between 30° and 60° from the vertical with the mouth clear of the water. The life jackets should be either yellow or orange for good visibility.

4.11.1.1 Inflatable Life Jackets

Manual and automatic gas inflatable Type I life jackets can be worn flat and folded against the body but neither becomes a life jacket until inflated. If you fall into the water unconscious, a jacket requiring manual inflation will be of little use. Under no circumstances should an automatically inflatable or inherently buoyant life jacket be worn while in a helicopter since, in the event of ditching, it will inflate and trap the wearer inside the emergency exits.

Manual and automatic gas inflation models need more servicing than a jacket with inherent buoyancy. The cylinders should be weighed at regular intervals to ensure the carbon dioxide has not leaked. According to manufacturers' instructions, company procedures and local regulating agencies, a thorough inspection program should be devised. Inflatable life vests should not be worn by non-swimmers.

Dual chamber / dual cartridge vests are preferred over single chambered vests as they will provide added protection in the event that one of the chambers on the vest is punctured.

4.11.2 EN PFD Classifications

50N Buoyancy Aids – EN393 (11lbs / 5.5kg of buoyancy)



These products are designed for competent swimmers, and are suitable for use in sheltered waters. They will only provide support to a conscious person who can normally help themselves.

100 Newton Lifejacket – EN395 (23lbs / 11kg of buoyancy)



These lifejackets are designed for both swimmers and non-swimmers and are suitable for use around inshore and coastal waters. They give a reasonable assurance of safety from drowning in relatively calm waters.

These products are NOT guaranteed to self-right an unconscious person wearing waterproof clothing and should not be expected to protect the airway of an unconscious person in rough water.

Under EU regulations, these lifejackets must be constructed out of a bright colored fabric with 100cm² of SOLAS reflective tape stitched to the front and provided with a whistle for attracting attention.

They are most commonly used on inland waterways and lakes or on the coast by craft operating reasonably close to shore in fair weather and fair sea conditions.

These jackets are often constructed in a foam waistcoat-style, making them simple to fit and relatively maintenance-free.

150N Lifejacket – EN396 (33lbs / 16kg of buoyancy)



These lifejackets are suitable for both swimmers and non-swimmers, and are designed for use in inshore as well as offshore and in all but the most severe conditions.

They give reasonable assurance of safety from drowning, to a person not fully capable of helping themselves (i.e. someone unconscious).

However they may not immediately self-right an unconscious person wearing heavy waterproof clothing that might trap air that could counter-act the normal righting moment of the lifejacket's buoyancy.

These lifejackets can be constructed out of foam (looking very similar to the orange foam lifejackets seen on ferries), or they can be of a low profile gas inflation design.

Under EU regulations, these jackets must be constructed out of a bright colored fabric (when inflated) with 300cm² of SOLAS reflective tape stuck to the front and provided with a whistle for attracting attention.

The EN396 150N gas inflation model lifejacket is the most popular type sold in the UK, particularly for leisure craft such as yachts and motor cruisers where their lower profile design is valued for being unobtrusive and easy to wear.

They can be supplied in both manual activation (inflated by pulling a toggle) and automatic water-activated models which inflate when they are submersed in water.

275 Newton Lifejacket- EN399 (62lbs / 28kg of buoyancy)



These lifejackets are suitable for both swimmers and non-swimmers and are designed to provide a high performance device for offshore and severe conditions, when maximum protection is required or where heavy waterproof clothing is worn that can trap air.

These products give improved assurance of safety from drowning, to people who are not able to help themselves (i.e. unconscious).

While they cannot be guaranteed to immediately self-right an unconscious person wearing heavy waterproofs that might trap air, the buoyancy that they provide should ensure that they will do so in the majority of cases.

Under EU regulations, these products must be constructed out of a brightly colored fabric (when inflated) with 300cm² of SOLAS reflective tape stuck to the front and provided with a whistle for attracting attention.






The 275N gas inflation model lifejacket is popular on leisure vessels that travel further offshore or on ocean passages in challenging conditions and also by smaller commercial operators that do not need to comply with full SOLAS lifejacket regulations but want the assurance that the improved performance offers.

The low profile design is also valued for being unobtrusive.

These jackets are normally supplied in automatic water-activated models which inflate when they are submersed in water.

Reference: ISO 12402 Lifejacket Standard

4.11.3 US Coast Guard PFD Classifications

Classification	Use	Advantages	Disadvantages
Type I Offshore life jacket 	Best used for open, rough or remote waters where the possibility of rescue may take some time. Minimum Buoyancy Ratings: 22 lbs.	Floats you the best Turns most unconscious wearers face-up in water	Bulky Not comfortable for extended wear
Type II Near shore buoyancy vest 	Intended for calm inland waters or where there is a good chance of a relatively quick rescue. <i>Examples of these vests would be the basic orange vests most boaters have onboard.</i> Minimum Buoyancy Ratings: 15.5 lbs.	Turn “some” unconscious persons to a face-up position. Less bulky and more comfortable to wear than a Type 1	Will not turn some unconscious wearers face-up Not for long hours in rough water
Type III Flotation Aid 	Ideal for calm, inland water or where there is a good chance for quick rescue. <i>Most common jacket used for recreational purposes.</i> Minimum Buoyancy Ratings: 15.5 lbs.	They are lightweight and comfortable for continuous wear. Come in many sizes and styles.	Will not turn an unconscious wearer to a face-up position. Wearer may have to tilt head back to avoid going face down. Not intended for survival in rough water or the open sea.
Type IV Throw able Device 	Designed to be thrown to a person in the water, grasped and held by the user until rescued. It is intended for calm inland waters with heavy boat traffic, where help is always present. One Type IV throw able device, which should be immediately available, is required on every boat 16 feet or larger. Minimum Buoyancy Ratings: 18 lbs.	Good backup to wearable flotation devices. Can be thrown to anyone in the water needing assistance.	Not for an unconscious person. Not intended for non-swimmers or children. Not intended for survival in rough water or the open sea.
Type V Special Use Device 	Designed and approved for specific activities as listed on its label. <i>Examples include work vests, board sailing vests, and commercial whitewater rafting and kayaking vests.</i> Minimum Buoyancy Ratings: 15.5 -22 lbs.	More convenient or useful for specific activities. Continuous wear prevents being caught without protection. Some Type V devices provide hypothermia protection, such as deck suits. A Type V Hybrid	Less safe than other types if not used according to label instructions. Some Type V's are approved only when worn. If marked this way, they are required to be worn to be counted as a regulation PFD.

Classification	Use	Advantages	Disadvantages
		Inflatable PFD is the least bulky.	

4.12 Swim Test



Before being allowed to participate in water-borne operations e.g., transition zones, lakes and those involving river crossings, personnel should be swim tested while wearing Personal Flotation Devices (PFDs) i.e. a life jacket. The swim test will, as a minimum, demonstrate the ability to swim 50 meters (150 ft.) in less than five minutes while clothed, plus maintenance of position (treading water) for two minutes. Swim

tests are conducted under strict control preferably in swimming pools rather than in lakes, ponds, rivers, streams or open water whenever possible.

Special precautions should be taken for non-swimmers. Non-swimmers should identify themselves and they should wear appropriate personal flotation devices (PFDs) at all times where applicable.

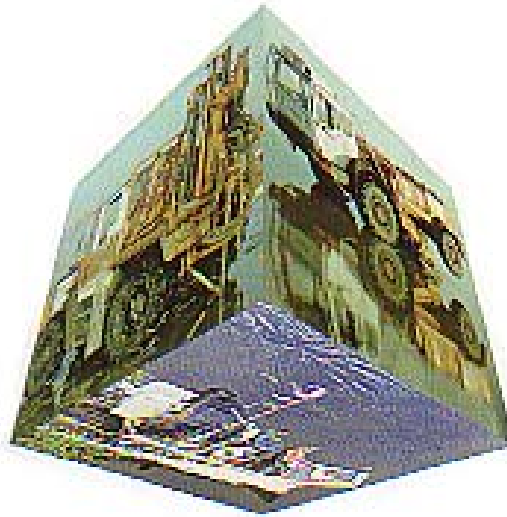
4.13 Respirators and Smoke Hoods

If the use of respirators or smoke hoods is being considered, then crew members should be properly trained. Local law may require physical examinations where a possibility exists that respirators will be used in the work place.

Respirators should have cartridge's compatible for the exposure. Users of respirators should be properly trained and the respirator fit tested to ensure adequate fit and seal. Users should also be trained in respirator maintenance, cleaning and sanitizing. When not in use, storage facilities to prevent contamination should be provided.

Breathing equipment should meet the specifications as set forth in the country of operations:

5. SEISMIC LINE



5 SEISMIC LINE

5.1 Fire

Fire Drills should be conducted to test emergency procedures and alarm systems. The crew should design a specific fire response plan for their facility and activities.

Do not fight a fire that is in imminent danger of contact with explosives. Fire fighters should not endanger themselves. Let the fire burn if the situation is getting beyond control. Everyone should move to safety and guard the fire area against intruders.

Personnel should be aware of this plan and use the following precautions to help prevent fires:

5.1.1 Fire Prevention Measures

- 1) The design of camps and facilities should integrate fire prevention such as minimum distances between tents and trailers (5 meters recommended), fuel and hazardous materials storage as far as reasonably practical and not uphill for example.
- 2) Generator compartments and fuel storage systems should be fitted with external emergency "shut offs" & vent closures if possible.
- 3) Use only specially manufactured cleaning solvents to clean mechanical parts. Gasoline, paint thinners, diesel oil, kerosene and other fuels **should never be used** for anything other than what they were originally intended. If Personal Protective Equipment (PPE) is not worn, fuels and other petroleum products may be absorbed through the skin and the released vapors inhaled by the user, causing serious health problems. Fire and explosion dangers are always present when petroleum products are being used.
- 4) Use non-volatile cleaning solvents to clean grease and spills. Use water-soluble degreasers when cleaning and washing inside or in areas in which ventilation is inadequate.
- 5) Use only approved containers to carry gasoline (petrol), kerosene, solvents and other flammable liquids. Plastic containers manufactured for food products and other non-petroleum products are not suitable containers for petroleum-based products. Petroleum-based products may cause rapid deterioration of this type of plastic container.
- 6) Label all containers as to their contents. Provide Material Safety Data Sheets (MSDS) for each hazardous product and post near product storage areas.
- 7) Areas used for storage of fuels, kerosene, solvents and other flammable liquid should be clearly marked as no smoking areas and as a hazardous area, and be isolated by distance from other facilities.
- 8) Use caution when discarding oily and greasy rags, use metal containers with a lid to dispose of them. Non-compatible petroleum products create a reaction that generates heat and can cause a fire.
- 9) Careless smoking habits are a major cause of fires. Smoking can be difficult to regulate. It is up to companies to define their own smoking policy.
- 10) All "No Smoking" areas should be clearly marked.

- 11) Place discarded matches, cigarette butts and other smoking materials in ashtrays or suitable containers only after ensuring they are completely extinguished. Designated no smoking areas should be posted with signs or other forms of notification.
- 12) When entering areas with tall or dried grass and/or wooded areas, check the undercarriage of your vehicle often for any trash, twigs, leaves, limbs, or grass. Turn the engine off, set the emergency brake and, if safe to do so, remove any of these items that are near the exhaust systems, especially around the manifold or catalytic converter. Wear gloves to prevent injury to the hands when removing these items. Park the vehicle in the clearest area available and try not to park in high grass or over large foliage accumulations. Keep a close watch on the vehicle when parked and / or when driving through these areas. Be prepared to extinguish a fire as quickly as possible.

13) Smoking Areas and Enforcement

Permanent "No Smoking" areas should include:

- | | |
|---|--|
| 1) Flammable liquid locker/paint locker. | 4) All food preparation, handling and storage areas. |
| 2) Battery storage areas and battery boxes. | 5) Bunks; trailers, tents |
| 3) Oxygen and acetylene bottle vicinity. | 6) Dining areas |
| | 7) Areas of dry vegetation. |

5.1.2 Fire Classification

Different countries classify fires with different alphabetic codes. The five classifications of fires.

Ordinary combustibles - Fires in brush, wood, cloth, paper, etc., these can be fought by smothering the fire. The use of sand, water, confinement, etc., puts out these fires by cutting off the oxygen supply; water also reduces the temperature.

Flammable liquids - Fires occurring in petroleum products (greases, oils, gasoline, etc.). Water is heavier than these products and when sprayed on the fire, splashes and spreads it by sinking below the surface of the material. This type of fire is best fought with foam equipment, dry chemical or carbon dioxide-type extinguisher or a water fog.

Flammable gases – Involve fire fuelled by flammable gases. DRY POWDER extinguishers may be used to smother the fire, but this should be combined with stopping the gas leak to remove the risk of the fire re-starting or an explosion. Use WATER to cool down valves to allow them to be turned off if needed.

Fires in energized electrical equipment - These present the problem of potential electrical shock. When electrical equipment is involved, always fight the fire as if the electrical current were on, unless you have definitely established that the electric current is completely cut off from the equipment involved in the

fire. Water is a good conductor of electricity; **do not use water on electrical fires**. This type of fire can be fought with carbon dioxide or dry chemical-type mixtures.

Combustible metals - Combustible Metals include Magnesium, Lithium, Titanium, aluminum, sodium, potassium, zirconium other flammable metals. Flammable metals generally take a very hot heat source to ignite; however, once ignited are difficult to extinguish as the burning reaction produces sufficient oxygen to support combustion, even under water.

In some cases, covering the burning metal with sand can help contain the heat and sparks from the reaction. Class D extinguishing agents are available (generally as a dry powder in a bucket or box) which can be quite effective. Combustible metal fire extinguishers come in different types depending on the type of metal fire. There are several Class D fire extinguisher agents available, some will handle multiple types of metals, others will not.

- Sodium Chloride Agents are used on Magnesium fires.
- Copper Based Powder for vertical melting lithium fires.
- Graphite based for lithium but will not work on melting lithium fires as well as copper based agents.
- Sodium carbonate is also used where corrosion is an issue.

Some water based suppressants may be used on certain class D fires, such as burning titanium and magnesium but some metals, such as elemental Lithium, will react explosively with water, therefore water-based chemicals should never be used on such fires due to the possibility of a violent reaction.

Blasting Agents – Although not considered a class of fire, nitrocarbonite, ammonium nitrates and other blasting agents are used in geophysical operations. These are listed as oxidizers and create their own oxygen as they burn. They cannot be fought by smothering. Confinement of this material during burning only increases the temperature and creates an explosion hazard. These fires should be flooded with water from the bottom up. Do not confine the fire.

5.1.3 Comparison of fire classes		
American	European/Australian/Asian	Fuel/Heat source
Class A	Class A	Ordinary combustibles
Class B	Class B	Flammable liquids
	Class C	Flammable gases
Class C	Class E	Electrical equipment
Class D	Class D	Combustible metals

Class K	Class F	Cooking oil or fat
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5.1.4 Fire Extinguishing Equipment

Fire extinguisher's compatible with the hazard and volume of material should be made available. Extinguishers carry ABC ratings and these should be used to determine the adequacy of the extinguisher and its intended service. Different class fires require different class extinguishers.

Fire extinguishers should be located in positions and locations so they are readily available. At least one extinguisher, of a suitable type, should be positioned near the access door to the area it is designed to protect. The locations of the fire extinguishers and their type should be as directed by fire code regulations or fire inspection audits.

Install a fully charged and inspected fire extinguisher in every vehicle in service (company-owned or leased). The driver of the vehicle is responsible for inspecting the extinguisher before the vehicle is used. Replace any damaged or stolen fire extinguisher. Dry chemical extinguishers are ineffective when the powdered chemical becomes compacted. Turn the extinguisher bottom up during monthly inspections and tap with a rubber mallet or similar tool, but do not dent or damage the extinguisher.

It is recommended that dry powder extinguishers be mounted horizontally on the vehicle so that the vibration does not cause the powder to pack down. The party chief or designated safety representative should periodically check all fire extinguishers to ensure serviceable operation.

Because of the possible damage to the environment by released fluorocarbons, Halon is no longer being manufactured and is considered illegal in some countries.

If a person's clothing catches on fire, wrap him / her in a blanket, rug, woolen coat, or any other natural fiber. Wrap around the head and neck first, and then have the victim drop to the floor or ground and roll over slowly. If there is nothing to wrap the person in, have them drop to the floor and roll over slowly. If water is available, douse and have them roll in the spilled water.

Fire extinguisher maintenance is crucial to office and operations safety. Keep fire-fighting equipment in good condition by following these guidelines:

- 1) Visually inspect extinguishers monthly. Each unit should meet the following requirements:
 - a) Mounted vertically where possible, in a designated place and at least 15 cm [(6 inches (in.))] from the floor.
 - b) Properly tagged with ID # and service record.
 - c) Sealed.
 - d) No visible physical damage.
 - e) No external corrosion.
 - f) Be readily accessible (not be obstructed).

- 2) Replace any extinguisher removed for maintenance.
- 3) Thoroughly service all portable fire extinguishers yearly.
- 4) Hydrostatically test portable extinguishers according to this schedule:
 - a) Water - 5 years.
 - b) Carbon Dioxide - 5 years.
 - c) Dry Chemical - 5 years for stainless steel containers; 12 years for all other containers.
- 5) Never expose CO2 fire extinguishers directly to the Sun.
- 6) When activating a fire extinguisher, never stand directly above it; always tilt it away from your body to prevent injury in case of failure/ explosion

5.1.5 Special Fire Fighting Procedures - Lithium Fires

It is important to follow instructions as posted on the battery MSDS. Never fight a lithium fire alone. Self-contained breathing apparatus and firefighting entry suits are required when fighting fires in confined spaces. There is no known fabric which offers complete protection from burning lithium. It is recommended to layer fire-retardant clothing such as Kelvar or Nomex and an aluminized overcoat.

5.1.5.1 Fire & Explosion Hazards

Fire will generate a white, caustic smoke (lithium oxide). Avoid skin contact & inhalation. Molten Lithium reacts explosively with water or concrete flooring. Solid lithium in water will liberate hydrogen and under certain conditions will explode. The rate of reaction increases the greater the surface area.

5.1.5.2 Reactivity Data

Lithium will react with air, oxygen, nitrogen and carbon dioxide. Incompatible with water, acid, halogens, and many other chemicals.

5.1.5.3 Extinguishing Media

Lithium fires are very hot and difficult to extinguish unless they are caught early. Lith-X is recommended for lithium fires. It acts by smothering the lithium. Lith-X tends to sink in and re-expose burning lithium. Re-ignition can occur if the Lith-X blanket is disturbed. If a lithium fire reaches large proportions, nothing can be done but to let it burn. DO NOT USE WATER OR CARBON DIOXIDE Note: For larger fires involving lithium batteries some sources do suggest that copious amounts of water may be applied, from a safe distance, to control the fire and protect adjacent materials and facilities.

5.2 Personal Security

5.2.1 Assessment

Before the project start-up, the security of the operation should be assessed or re-assessed in the event of changing conditions.

5.2.2 Procedures

Security procedures should be in place covering a range of situations including:

- Assault;
- Robbery/theft;
- Abduction/missing persons;
- Threats by telephone;
- Cargo/baggage integrity;
- Vandalism/sabotage;
- War/terrorism/piracy;
- Civil disobedience/strikes.

5.2.3 Personal awareness

Personnel involved in the project to be trained in basic preventive measures to reduce potential security Incidents. Where assessment identifies a security risk to personnel, guidance should be provided on appropriate behavior in the event of a security incident. A policy of 'no resistance' is recommended.

5.2.4 Potentially aggressive interference or intervention by third parties to the project

In the project risk assessment, identify, assess and document the risks that might exist from third party activities. Each crew should document the procedures that are to be followed in the event of interference/intervention by a third party, including interface issues between client/contractor/subcontractor events to be addressed might include:

- Interference with vessels/vehicles/equipment by a third party;
- Radio contact from a suspicious third party;
- Third party puts themselves or crew members in danger;
- Third party shows aggression towards the crew personnel
- Third party attempts to take possession of crew property.

5.3 Explosive Remnants Of War (ERW)

In countries affected by ERW, it's important that crew personnel have the most up to date information available regarding the detailed location of ERW affected sites or what are internationally known as Suspect Hazardous Areas.

- If ERW-affected sites are identified during surveying or recording operations it is important to stress that under no circumstances should untrained personnel investigate suspicious objects.
- This information should be initially reported to the HSE Manager or Security Advisor in the form of an ERW Find Report. An ERW Find Report should be filled out so that accurate and timely information can be passed on to the ERW service provider.

5.4 Unexploded Ordnance UXO Clearance

A comprehensive set of UXO clearance procedures should be developed based on the client's specialized assessment of the area. These should include but not limited to:

- Compliance with relevant local military and civil regulations;
- Qualified specialists will be contracted to locate and destroy UXO
- Provide visible marking of hazardous zone
- Strict enforcement of procedures on access to danger areas;
- Go/no-go instructions;
- Daily report on UXO clearance and accessible areas;
- Training and meetings on the danger of UXO and identification of restricted areas;
- Provision and use of specialist UXO clearance PPE.

5.5 Permitting

Permit agents are typically the first exposure that the general public in an area will experience of geophysical operations. The permit agents are usually employed from the local community, and they need to be fully incorporated into the contract HSE plan. It is important that they establish good rapport, especially in areas with civil unrest, to avoid disruption of operations. It is necessary to respect the culture, religions and politics in each community for permitting to be effective, and for the work to be carried out without causing problems with the local community.

Permit agents gather information and communicate it through the company's organization. They can also play an important role in identifying hazards and providing information for the crew's emergency plan. Select and educate permit agents to act appropriately in the region regarding damages from the work. Local security agencies, such as police, military, fire brigades, etc., should be made aware of our needs to assure proper response to unforeseen situations.

It is important to assure prompt and equitable settlement of any disputes in order to avoid retaliatory actions, such as vandalism, theft, or personal harm to employees.

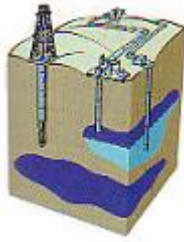
5.6 Community Relations

IAGC companies should strive to be good citizens in the communities in which they operate. Activities, which can demonstrate this commitment, include the following:

- 1) Compliance with all applicable regulations.
- 2) Application of responsible standards where regulations are non-existent.
- 3) Communication with the general public on issues, which may affect them.
- 4) Working with government and industry to promote good practices.
- 5) Planning to respond appropriately to emergencies.
- 6) Audits of crew operations to assure responsible performance.
- 7) Training the work force in responsible community affairs.
- 8) Recruitment of personnel from the areas of operation when practical.

These activities should be undertaken in conjunction with client companies' efforts. In areas with civil or social unrest, security of company personnel is a primary concern.

5.7 Buried Hazards



Seismic drilling can encounter various buried hazards. Identification and detection should be a major part of the pre-planning of any survey. It is important to ensure that all associated hazards, i.e. pipelines, electric cables, etc. have been identified, located and if necessary isolated.

Pipeline precautions should include both active and abandoned lines, lines carrying all types of fluids and gases, all types of pipes such as metal and plastic and pipelines which are buried, on the surface or suspended.

Basic rules:

- 1) Regardless of your efforts, there are probably buried hazards you do not know are there.
- 2) A damaged pipeline, water supply, electricity supply will usually cause a safety or environmental emergency.
- 3) The detection of buried hazards requires the close attention of every person on the crew. Be observant and report all suspected buried hazards.

Precautions:

- 1) Identification of buried hazards requires that careful research be done of any available information or maps. You should contact the field operator(s), municipalities, government agencies and local inhabitants to locate any and all buried hazards.
- 2) In some locations there are pipeline location companies, usually a "one call" telephone number, aerial survey companies and aerial maps. All are very helpful locate pipelines and other buried hazards.
- 3) There are several pipeline detection devices, which may assist the crew in pipeline avoidance. Plastic or PVC pipes cannot be detected with metal detectors.
- 4) The company and client should mutually agree upon safe offset distances for vibroseis and shot hole operations. One set of offset specifications will rarely apply to every project.
- 5) In H₂S (Hydrogen Sulfide Gas) areas, a broken pipeline will extend the H₂S hazard well beyond the well head area, which is normally perceived as the hazardous area. H₂S precautions and training should extend over the entire survey area where H₂S hazards exist.
- 6) Pipelines present the most significant hazard to bulldozer operations, vibrators, and shot hole drills.
- 7) An emergency response plan for dealing with a damaged pipe line should include procedures for reporting:

- a) The specific pipe, if known and location of the damage. The response plan could also include a map with pipelines marked and named for easy reference.
- b) The extent and type of damage if known.
- c) To proper authorities and pipeline owner.
- d) What efforts have been made to contain the spill,
- e) What cleanup efforts, if any are underway.

Any injuries should be dealt with under the medical response plan, which should include the location and activation of medical help.

- 8) When operating in areas where major pipelines are unavoidable, pipeline monitoring stations should be advised of crew operating schedules.
- 9) Aircraft surveillance is often used on major pipeline routes.
- 10) Current aerial photography can be very useful in pipeline detection.
- 11) All known pipeline routes and pipeline crossings should be clearly noted on the crew daily operating sketch map.
- 12) When operating in areas with exposed pipelines where the crew must track over them use designated crossing points where the pipes are buried as deeply as possible. Where this is not practical protect the pipe with wooden logs on either side to form a bridge. On no account should the vehicle's weight be allowed to rest on the pipeline.

5.8 Communications

5.8.1 Radios and Telephones

Communications between base-camp, fly-camps and field operations are essential at all times but especially in the event of an accident or medical emergency. Procedures should be in place for emergency first aid treatment and evacuation. The Emergency Response Plan (ERP) including telephone numbers of paramedic or HSE Advisor, doctors, hospitals, etc., should be displayed in the radio room and camp office. Radio communications between working groups are important in promoting crew safety. Knowledge of the movement of working groups (i.e., direction of travel and length of absence) could save time if an emergency situation should arise. More than one person within each working group should be familiar with communications equipment and procedures. Each operating unit should have a working radio, and the base camp radio should be manned at all times while personnel are in the field. Authorized cell phones and satellite phones are commonly used and supplement radio use.



5.8.2 Global Positioning Systems (GPS) and HSE

The Global Positioning Systems (GPS) has provided a useful tool to assist in Medevac, Search and Rescue, Civil Unrest and Evacuation as well as environmental emergencies. If you know where you are, where you want

to go, and if you can communicate those positions, HSE response is significantly faster. These procedures are applicable to most exploration areas.

It may be desirable to have a Global Positioning Systems (GPS) receiver in major trucks, crew management vehicles, bulldozers, buggies, snow vehicles, aircraft (fixed wing and rotary) and boats. When traveling over open water, flying over jungle, desert, rain forest, or snow fields, the terrain all looks the same and having the assurance of a Global Positioning System (GPS) position is essential.

Working in “politically unstable” areas requires pre-planned evacuation routes and backup procedures. A portable GPS receiver and spare, loaded with way-points obtained during actually dry-running the evacuation route would be beneficial should an evacuation be necessary.

The Global Positioning System (GPS) is an excellent tool in locating and avoiding rivers, quick sand bogs, sand bars, snow crevasses, environmentally sensitive areas, artifact and cultural resources and anything that may require a location identification.

All personnel who are assigned to a crew that may have an emergency evacuation or who may have to use a GPS unit should be trained in its use.

5.9 Surveying



Surveyors are frequently the first member of the party to enter a location. They should assess the hazards and risks and communicate them to other party members. These hazards include, but are not limited to: dangerous animals, insects (bees), underground pipelines or electric lines, electric fences, hunters in the area, old cisterns, wells, mines or partially concealed holes or pits, posted poison gas areas and natural obstacles.

1) The surveyor should prepare a sketch map for distribution to all crew members showing the location of all points of danger, including but not limited to:

- | | |
|--|--|
| a) Power, oil, gas, water and telephone lines. | e) Fences. |
| b) Radio, television and radar transmitters. | f) Animals and insects (such as bees). |
| c) Weak, narrow or low bridges. | g) Access in to and out of the survey areas. |
| d) Holes or pits. | h) Water hazards |
| | i) Archeological sites |
- 2) When surveying a line, be alert to the location of radio, television and radar transmitters. Advise drilling and explosives crews of their locations. Identify the type of transmitter, power and frequency and then refer to tables published in the Institute of Makers of Explosives Regulations (IME) Volume 20 - SAFETY GUIDE FOR THE PREVENTION OF RADIO FREQUENCY RADIATION

HAZARDS IN THE USE OF COMMERCIAL ELECTRIC DETONATORS (BLASTING CAPS) for recommended offset distances for shot holes.

- 3) If you do not know the power output of your radio, ask your supervisor. The information contained in the previous table could save your life.
- 4) Do not position a shot point closer than twice the depth of the shot hole (or more if required by local regulations) from any overhead power line. This is to keep the length of the detonator wire, plus firing line, from accidentally blowing over the power line. Other means of achieving this include detonator wire catchers or sand bags sufficient to stop the detonator wire blowing out of the hole.
- 5) Use extreme caution when working near bulldozers, woodgators / mulchers, or chain saws when clearing the line.
- 6) Surveyors should utilize existing paths or tracks for survey lines and access routes wherever possible.

5.9.1 Brush/ Line Cutting

- 1) Subject to risk assessment Brush/ Line cutters should receive and use the following Personal Protective Equipment (PPE):



- Friction tape on the tool handles.
 - Work boots providing ankle support and protection.
 - Shin and knee protectors.
 - Hard hat.
 - First aid kit (one per work unit).
 - Machete sheath.
 - Eye and face protection. Where applicable
 - Use a guard stick. This is a stick held in the opposite hand to the machete and used to balance the body when slashing. It also serves to protect the legs if you inadvertently slash towards them.
- 2) The end of the machete's blade should be round.
 - 3) Machetes should be inspected daily at the start of work for defects; defective machetes should be replaced or repaired. Keep all cutting instruments sharp.
 - 4) Machete sheaths should be carried at all times and should be used when the machete is not in use. Always keep the sheaths with you.
 - 5) Machete users should be separated at least 3 m (10 ft.) apart.
 - 6) Users should check the work area for other workers and hazards before they begin to cut. Always alert other workers before entering their work space.
 - 7) Less force should be used on the first strike to test the strength of the root or limb.

- 8) When working in areas of tall grass, line cutters should use leaning sticks and the specially designed wide machete for line clearing.
- 9) Never strike toward lower body.

5.9.2 Chain Saw Operations



Chainsaw operations should be avoided where possible but if their use is required it should be done under close supervision and all safeguards put in place. Chain saw cutting operations should be carried out with extreme caution and a high level of safety awareness. All operators should be formally trained and skill-tested by a competent assessor before being employed in order to ensure that they are qualified. Only operators who perform their duties while complying with all the safety standards should be authorized to operate chain saws on the crew. Each operator should be issued a Daily Safety Checklist for the chain saw. Operators should be familiar with this checklist and follow all of the standards listed. Only chain saws with automatic chain break should be used.

Before operations start, a review should be undertaken of regulations and conditions under which trees may or may not be cut down.

All operators should have and use the following Personal Protective Equipment (PPE):

- 1) Lumberjack helmet (a hard hat with eye and ear protection).
- 2) Gloves.
- 3) Safety (steel-toed) shoes.
- 4) Approved chain saw chaps or pants.

Other safety equipment that should be issued:

1. Proper fuel and an oil container with funnel.
2. First aid kit for chain saw operations with pressure bandages. (One per work group)
3. Cutter bar guard for saw.
4. Spare spark plug.
5. Chain file.
6. Screwdriver.
7. Plug wrench.
8. A whistle or other warning device.

Note: Major repairs should be completed by a mechanic.

The following safety standards should be emphasized to all chain saw operators:

- 1) No operator should operate the chain saw without wearing Personal Protective Equipment.
- 2) Radio communications should be available between the operating site and a unit capable of medevac.
- 3) Never cut above shoulder height or operate the chain saw with one hand. Always keep the cutting direction away from you. Always use the bottom of the blade for cutting; never use the top or the tip.
- 4) Clear the area of all personnel before the operator uses the chain saw. When felling a tree, all crew members should be grouped a distance that is at least twice the tree height away. The chain saw operator should have a planned escape route before cutting any tree.
- 5) A whistle or alarm should be sounded prior to a tree falling.
- 6) Make sure the chain is properly tightened. Make sure a mechanic regularly maintains the saw and updates the log book. A sharp chain is safer.
- 7) Always allow the chain saw engine to cool before refueling. The chain saw should not be restarted at the location where refueling took place as fuel spillage can catch fire.
- 8) Mix fuel with two-stroke oil. Use the proper chain bar oil on the chain. Use a funnel when refueling if the fuel container does not have a spout funnel.
- 9) Never transport a chain saw while it is operating. Always turn the engine off and place the guard on the cutter bar before moving. Carry the saw with the bar facing behind.
- 10) Never carry the chain saw on your head.
- 11) Start the chain saw only when it is placed firmly on the ground.
- 12) Operate the chain saw only when stable footing is available. Do not stand downhill while cutting.
- 13) Use the chain saw only when necessary.
- 14) Chain saws should be fitted with a working chain brake, kill switch and kickback safety stop.
- 15) Minimize the amount of vegetation disturbed. Helipads and drop zones may require the cutting of large trees. Local environmental restrictions need to be considered.
- 16) Clearing the seismic line can normally be accomplished without removing trees greater than 20centimeters (8 in.) in diameter.
- 17) Leave in place smaller vegetation, low shrubs and grasses consistent with a safe walking surface.
- 18) Remove leaners and hung up trees to prevent them falling unexpectedly later on.
- 19) Do not build fires when the vegetation is dry.

- 20) Do not fell trees across pipeline right of ways, trails or water courses.
- 21) Try to cut and scatter limbs such that tree trunks fall flat on the ground. Good ground contact speeds up decay.
- 22) Where needed back-sighting is blocked by a branch, remove it rather than the whole tree.

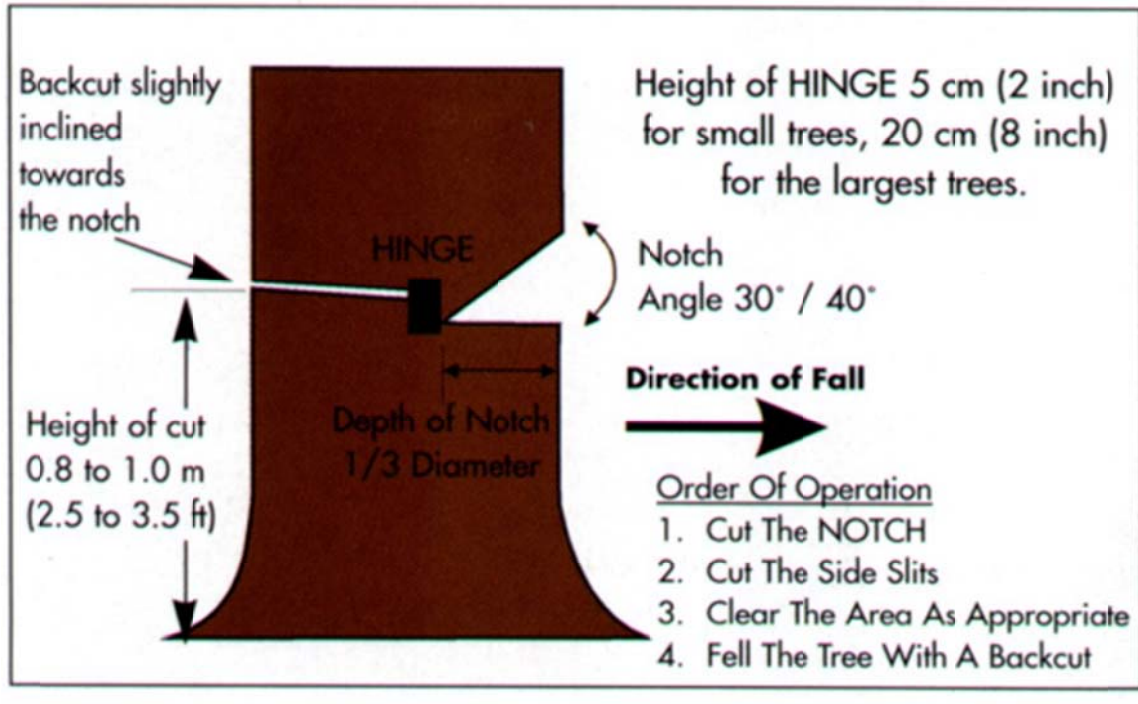


Figure 6 - Tree Notching Diagram

5.9.3 Bridging

The construction of rugged bridging is sometimes required to provide safe footing.

The following types of bridging are recommended. Their measurements are given with their descriptions as a guideline. In some countries for environmental reasons, slope bridging is not allowed. In these instances, specially trained and experienced people in the use of ropes, harnesses, and other special tools are needed to work in mountainous terrain.

There are three types of bridges most commonly used:

- 1) Swamp bridge.
- 2) Mud flat bridge.
- 3) Slope bridge.

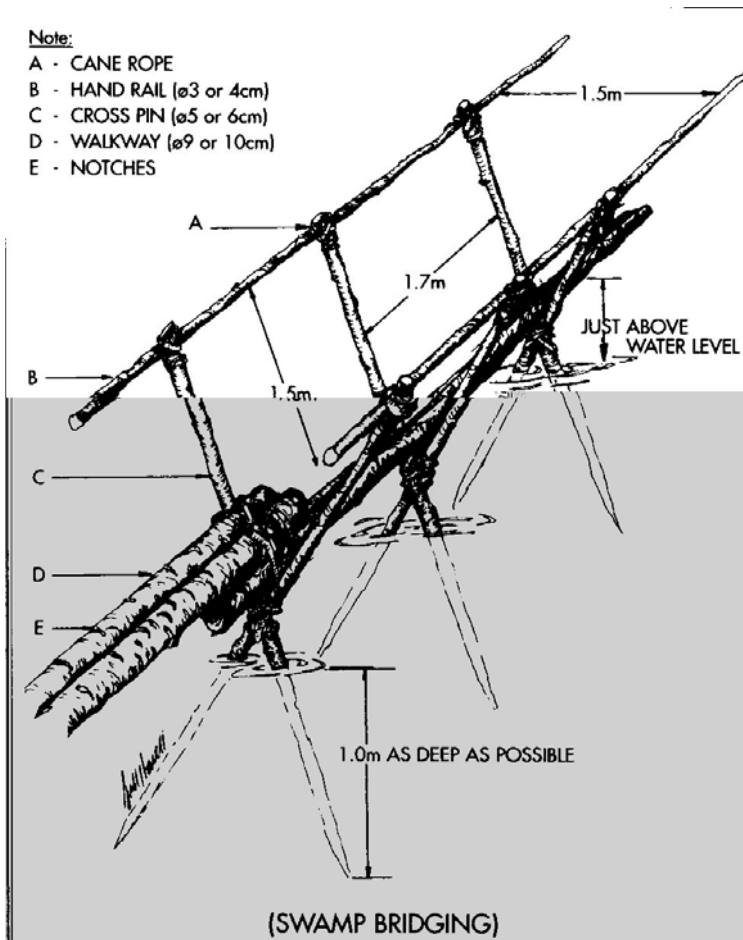
A poorly constructed bridge is far more dangerous than no bridge at all. If materials are not available for a swamp type bridge, then use a mud flat-type bridge.

In selecting bridging materials, consideration should be given to local environmental and conservation efforts.

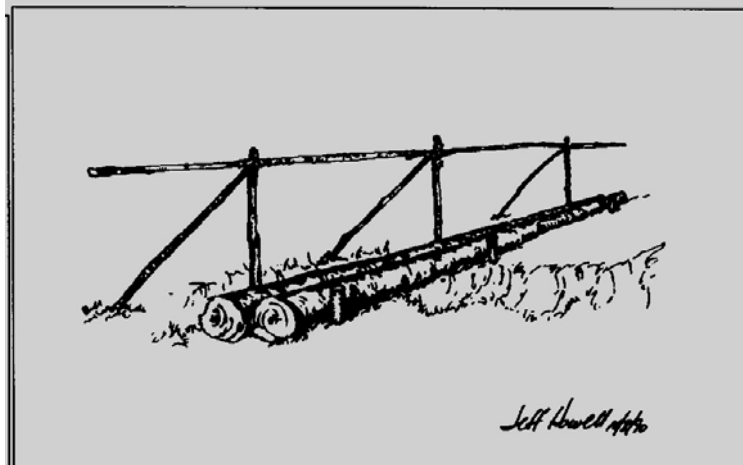
In many cases, it is safer to find a different way to access the line. Bridging should only be used when absolutely necessary. In some cases it may be safer to walk in mud and/or water than to try to negotiate a bridge.

Note:

- A - CANE ROPE
- B - HAND RAIL (ø3 or 4cm)
- C - CROSS PIN (ø5 or 6cm)
- D - WALKWAY (ø9 or 10cm)
- E - NOTCHES



Mud Flat Bridge



5.10 Recording Operations

- 1) To prevent fires, the recording vehicle should not be parked in an area of tall grass and brush. In some countries it is required that vehicles have high level exhausts and spark arrestors fitted.
- 2) In the event of an approaching electrical storm, stop all operations and disconnect cables from the recording truck. Disconnect at key points along all seismic lines. Personnel should be instructed to move to a safe distance from any loaded shot holes or explosives.
- 3) When laying out or picking up cable by vehicle, be aware of low limbs, bushes, low hanging wire and other hazards.
- 4) Cable handlers feeding the cable in or out of the truck should have the emergency horn button in close reach. Never guide or hold the cable while it is being fed from or into a cable squirter.

Trucks should be equipped to prevent cable handlers from falling or injuring themselves. Limiting the truck speed (15km/h) is the main control.
- 5) When handling the cable manually, do not overload yourself. Never jump ditches or climb over, through, or under fences while carrying a load. Do not descend or climb embankments while carrying a heavy load, get help. Be extremely careful when looping cable over your head when picking it up.
- 6) Use extreme caution when coiling the cable around your body. Serious injury will result if a passing vehicle snags one end of cable.
- 7) Never sit or stand on a string of geophones. The spikes can cause a puncture injury.
- 8) Do not jerk or pull excessively on geophone strings. It will either damage the equipment or the geophone will dislodge and hit someone causing possible injury. Gently kick individual geophones before picking up.
- 9) When a truck-mounted recording operation is used, the exhaust system from the engine should be checked periodically to ensure that exhaust fumes are not entering the recording cab. Propane and other heaters should be properly vented. Carbon-monoxide detectors are recommended inside the recording cab.
- 10) Pick up debris, garbage, pin flags, survey stakes, flagging, etc. either daily or at the end of the job.

5.11 Lightning Protection

Lightning is one of nature's most dangerous and devastating phenomena. It is responsible for many deaths, injuries, equipment damage and forest fires. Some locations are more prone to severe electric storms.

Lightning usually strikes the highest point or object in any area because it is seeking the shortest path.

Since lightning may strike almost anywhere, take the following precautions when an electrical storm approaches:

- 1) Suspend all explosives operations; this includes moving away from explosives and detonator storage magazines. If you are carrying explosives, lay them down and move at least 30 m (100 ft.) away. Do not make up charges during an electrical storm nor while it is approaching. Wait 30 minutes after the storm has passed over. Do not load holes or go near the charges, or loaded shot holes until the storm has passed. There are special recorders available that detect lightning strikes.
- 2) When you see or hear an electrical storm approaching (keep a radio watch for storm announcements)
 - a) lower the mast of the drill
 - b) move the drills away from overhead power lines
 - c) move all personnel away from the drills.
- 3) Disconnect all lines from the recording instruments. Make sure all recording cables and geophones are not touching fences. Disconnect all cable lines at as many places as practical.
- 4) If you are carrying hand-held, radios, do not transmit and either remove the antenna or walk with the antenna pointed downward, but not touching the ground. Consideration should be given to laying the radio on the ground and not holding it during electrical storms.
- 5) Lay all metal tools, loading and survey range poles, pipe, or drill stems on the ground and away from you..
- 6) Stay away from trees, power lines, cables (coiled or out on the ground) and fences. The lightning current can travel long distances along wire fence.
- 7) Suspend operations (e.g. fuelling, explosives handling) and move clear of flammable & explosive materials.
- 8) Suspend small boat operations; personnel get off the water.
- 9) You are safer inside a rubber-tired vehicle but park it in a low open area rather than under trees.

Lightning conductors are recommended for metal structures that are not grounded. Explosive magazines made of metal should be grounded. An approaching electrical storm will create static on AM radio stations. This can be used as an indicator of potential lightning in the area.

5.12 Hazardous Materials (HAZMAT)

Crews may have products known as Hazardous Material or HAZMAT, ranging from paints and solvents to cleaning agents. Each Hazardous Material (HAZMAT) product is generally safe to use if the manufacturer's instructions are carefully followed. Mixing or combining products or chemicals can often result in dangerous situations, which may cause harmful vapors, explosion, or serious eye and skin injuries. All HAZMAT containers and packaging are labeled with identity and warning signs.

All Hazardous Material (HAZMAT) products should be supported by a Material Safety Data Sheet (MSDS) which lists critical information on the specific product or chemical, such as content, explosion/flammability rates, safe handling procedures, spill/clean-up information, Personal Protective

Equipment (PPE) required and first aid measures. Hazardous Material (HAZMAT) training for employees who handle hazardous materials should be documented.

Correct HAZMAT posters and labels should be posted in full view of personnel using or coming near the hazardous materials. All waste materials should be disposed of correctly as per the MSDS sheets. MSDS



information sheets should be posted and be easily available near the chemical storage space for review prior to using the product and kept on file in the crew office for quick access in case of emergency. The first aid measures in the MSDS should be readily available at the point of use.

5.12.1 Batteries

Batteries are a hazard and can present a high risk if not cared for and used properly. Different types of batteries require different procedures for handling, charging, connecting and disposing of used or spent units.

- 1) Battery storage areas, boxes and charging spaces should be well ventilated and kept free of flammable products, explosive gases, open flames, electrical spark hazards, metal objects and portable power tools or lamps.
- 2) Battery storage areas should not be used as store rooms for any material or products and no unauthorized modifications or additions should be made to any electrical equipment or fixtures in the storage area.
- 3) Proper Personal Protective Equipment (PPE) should be worn at all times when handling or transporting batteries (rubber gloves, rubber apron, face shield or goggles). An eye wash station should be located near the battery charging and handling area for immediate use in case of an accident. No smoking signs should be posted at the charging area.
- 4) Jewelry, watches, rings, etc., should be removed when working on batteries. A short circuit through any of these items will heat the metal object rapidly and cause severe burns. If rings cannot be removed, they should be taped with insulating material.
- 5) All battery connections should be kept clean and tight to avoid sparking and overheating. Insulation and/or guarding of all battery terminals and cables should be maintained in good condition. ***Never short circuit a battery.***
- 6) All circuits fed by the battery should be switched off when the leads are being connected or disconnected. If a battery is in sections, it may be possible to reduce the voltage between cells in the work area and hence, the severity of an accidental short circuit or electric shock by removing the jumper leads between sections before the work is begun.
- 7) Battery cell vent plugs or caps should be tightly secured except during charging when they should be loose. The ventilation tubes of battery boxes should be examined regularly to ensure that they are free from obstruction.

New technology and developments in stored energy devices (batteries) offer different alternatives to many systems now being used on crews. Each type of battery is constructed differently and requires special handling and safeguard procedures. Know the type of battery you are using and consult the manufacturer's safety and handling instructions before installing, charging or placing in service.

5.12.1.1 Lead-acid Batteries

- 1) Acid electrolytes are highly corrosive. Immediate remedial action should be taken to wash off any splashes on the person or on the equipment. Hands and clothes should always be washed as soon as the work is complete. Always add acid to water never the other way round.
- 2) To neutralize acid on skin or clothes, wash with ample quantities of water. Goggles, rubber gloves and a protective apron should be worn when acid is handled.

5.12.1.2 Lithium Batteries



- 1) Never attempt to charge a lithium battery, unless designed to be charged, such as the batteries in Laptops.
- 2) Never short-circuit a lithium battery.
- 3) Lithium batteries are transported and stored under regulated and usually restricted conditions. Consult the battery manufacturer or original shipping containers for exact storage and use/care instructions.
- 4) Do not expose lithium batteries to moisture and protect individual batteries from contacting any metal (including other lithium batteries) during storage.
- 5) Correct disposal procedures should be followed. **NEVER PUT IN A FIRE.**

5.12.2 Hydrogen Sulfide (H₂S)

5.12.2.1 Hazards and Characteristics



Personnel should receive appropriate H₂S training before working in areas where an H₂S hazard exists. This training should be documented.

H₂S is most likely to be encountered where there is oil and gas production, pipelines and sewage plants. The principal of H₂S is death by inhalation. When the amount of gas absorbed into the blood stream exceeds that which is readily oxidized, it acts on the nervous system and systemic poisoning results. Labored respiration quickly occurs and respiratory paralysis immediately follows at higher concentrations. Minute amounts of H₂S are lethal.

Exposure may cause the following symptoms to occur individually or in combinations: headache, dizziness, excitement, nausea, coughing and drowsiness.

H₂S cannot be detected solely by smell since the gas rapidly paralyzes the sense of smell. H₂S has the following characteristics:

- 1) Extremely toxic, ranking second to hydrogen cyanide and five to six times more toxic than carbon monoxide.
- 2) Colorless and transparent.
- 3) An offensive odor, like rotten eggs. But in high concentrates, it is odorless.
- 4) Heavier than air. Vapor tend to accumulate in low places.
- 5) Flammable and forms an explosive mixture with air.
- 6) Has an auto-ignition point of 260°C (500°F) Note: cigarettes burn at 760°C (1400°F).
- 7) Burns with blue flame and produces sulfur dioxide (SO₂), which is less hazardous than H₂S, but irritating to the eyes and lungs and can cause serious injury. Chemical pneumonia can develop in a few hours.
- 8) Soluble in both water and liquid hydrocarbons and may be expelled from the produced fluids.
- 9) Produces irritation to the eyes, throat and respiratory system.
- 10) The Threshold Limit Value (TLV) is a maximum of 8-hour exposure at 10 parts per million (ppm) without respiratory equipment.

The following table lists the physical effects of H₂S

Concentration PPM	Physical Effects
0.02	Odor Threshold
10	Safe for 8-hr exposure; Obvious and unpleasant
100	Kills sense of smell in three to 15 minutes; May sting eyes and throat
200	Kills sense of smell quickly; stings eyes and throat
500	Dizziness; breathing ceases in a few minutes; Need prompt artificial respiration
700	Quickly becomes unconscious; Death will result if not rescued promptly (30 min.)
1000	Unconscious at once; death follows in a few minutes

5.12.2.2 Detection



Knowing the limitations and capabilities of your detection devices can save your life. When testing, always be prepared for a high concentration of the gas.

Do not attempt to rescue someone yourself unless wearing an appropriate breathing apparatus.

Action Plan in H₂S Areas:

- 1) Prior to entering an H₂S area, all personnel working in posted areas should attend hydrogen sulfide safety training conducted by certified instructors.
- 2) Absolutely no smoking or open flames are permitted while in posted areas or where H₂S exists.
- 3) A fully detailed and documented field crew evacuation (and head count) procedure should be established prior to entering the posted area. (part of the crew Emergency plan)
- 4) Detectors and escape packs should be available to all persons working in an H₂S area. Individually or collectively according to risk assessment.

5.13 Extreme Weather Conditions

Special rules & training should be devised for each crew operating under extreme conditions of heat, cold, dampness, darkness or dryness. Factors to be considered in setting up such rules are listed below:

- 1) A matrix or manual of permitted operations (go / no go criteria) should outline operating restrictions. Limitations for operating in extreme temperatures, reduced visibility & high winds should be considered.
- 2) The need for warming or cooling periods should be discussed with personnel operating in extreme climates. Adequate shelters should be provided.
- 3) A work plan, travel plan and expected time of return should be filed or communicated before leaving camp. Check in periods should be established. Personnel should be accounted for at all times and be familiar with the crew's "Journey Management System."
- 4) Vehicles operating in extreme cold, deep snow, desert, or other conditions where personnel might become stranded should have emergency rations, water, radio and signaling or locating devices. Personnel should stay with their vehicles when any problem occurs. Do not attempt to leave the location. It is easier to search for and locate a vehicle than an individual. Vehicles tracking systems should be fitted.
- 5) Personnel should wear sufficient clothing in cold weather to minimize the danger of freezing if stranded. It is easy to remove excess clothing. Clothing should be layered rather than a single heavy item. Parkas with hoods should be provided for cold climates. Synthetic materials or wool that retains body heat when wet should be considered for extreme cold environments and absorbent cotton fabrics that wick away moisture should be considered for extreme hot climates.
- 6) Protective footwear should be provided that is suited for the climate. The advantages and disadvantages for steel toe or composite footwear should be evaluated based on a risk assessment considering the operating temperature. Footwear with removable liners should be considered in extreme cold environments. Spare liners should be provided. In extreme cold environments, work boots equipped with softer treads (ice / anti-slip) may provide better traction.

- 7) The use of traction devices may be considered for working on ice or working on icy roads. These devices may introduce a trip hazard as well so their use should be evaluated carefully.
- 8) If hard hats are a requirement then consideration should be given for liners in colder regions. Hard hats and liners may not provide adequate protection from the cold and they may increase the risk of frost bite and heat loss so this should be evaluated carefully. In extreme hot climates, vented hard hats should be considered to allow heat to escape. Absorbent sweat bands and sun shade visor attachments may also be considered for hard hats in extreme hot climates.
- 9) Sunglasses / goggles should be worn to reduce glare and to protect the eyes from blown (snow, desert sand & rain) where applicable. Consider anti-fogging goggles for extreme cold climates. A set of yellow or amber tinted safety glasses should be offered to personnel working in flat-light conditions. Clear lenses should be available for night or operations conducted in continuous darkness. Although more expensive - filtered or polarized lens reduce glare dramatically in bright light. Filtered lenses actually block specific spectra of ultraviolet light, which results in enhanced contrast and definition. Both types of lenses are well-suited for on-snow use.
- 10) Head lamps should be provided for working in continuous darkness.
- 11) Face masks or face protection should be provided to protect from frost bite in cold climates and windblown sand in the deserts.
- 12) Radios in vehicles and all operating locations should be kept in operating condition. A routine daily radio check-in schedule should be used between all field operating units and the base camp. Base radios should be monitored during working hours and routine daily radio checks should be made.
- 13) Each independently operating vehicle should contain an emergency kit, the contents of which should be defined according to local conditions. In extreme hot weather each vehicle to carry a foldable tarpaulin to provide shade during work rest. Emergency instructions should also be available in each vehicle.
- 14) Extreme cold affects equipment - Check operator's manuals and manufacturer's product data sheets for minimum operating temperatures of the equipment and fluids used. This is especially important for hydraulic hoses.
- 15) Extreme cold that affects personal safety (Check yourself and your team for signs of frostbite and hypothermia, which can set in gradually, before you notice them). Personnel should familiarize themselves with the symptoms of heat and cold related illnesses. (See following section on frost bite)



5.14 Ice Safety

Know what you're doing on the ice! Work on ice covers starts with recognizing hazards and knowing how to handle them. Plan your work—

and your safety—with the following in mind.

- what you plan to do, where, and for how long (Check your Ice Safety Plan. Talk to your supervisor).
- conditions and limits on the ice cover fresh or sea ice (Check your Ice Safety Plan for ice thickness, speed, load and time limits).
- weight of the load you plan to put on the ice cover (Know your GVW).
- sudden changes in temperature ($\pm 20^{\circ}\text{C}$ in 24 hours) (Check current conditions. Look at the ice).

5.14.1 Self-rescue in freezing water

If you fall through the ice, you have time to save yourself.

1 minute to control your breathing

For about one minute, you'll gasp for air, in reaction to the extreme cold. After one minute, the gasping gets less, the skin numbs and the feeling of intense cold lessens.

10 minutes to get out - You have about 10 minutes to get out of the water:

- **tread water:** Don't panic and thrash about. Resist the urge to gasp. Instead, slowly tread water or grasp the edge of the ice to keep your head above water.
- **kick and pull:** Keep your hands and arms on the ice and kick your feet. This brings your body to a horizontal position, parallel to the ice surface.
- **horizontal kick and pull:** Once you're horizontal, continue to kick your feet, while pulling with your hands. Draw yourself up onto the ice.
- **roll onto the ice:** Keep your weight spread out as you roll, crawl and slide to reach ice that can support your weight.

5.14.2 Personal safety equipment

When working on ice covers, make sure you've got the right equipment for the job and the conditions, check your Ice Safety Plan. Then check your PPE.

Suggested PPE:	What you need it for
warm clothing worn in layers	to protect your face, head and neck, and maintain core body temperature
rubber-soled, felt-pack winter boots	to walk without slipping and keep your feet warm and dry
insulated waterproof gloves, mittens and over mitts	to keep your hands warm enough to work and carry out emergency tasks
sunglasses	to protect your eyes from snow blindness and glaring reflections off ice and snow
whistle	to call for help or signal others
high visibility flotation suit	to keep yourself afloat and warm in icy water
30 meters of 10-mm thick buoyant	to rescue others or be rescued if the ice fails

polypropylene rope	
ice rescue picks	to grip and move along the ice to complete a self-rescue if the ice fails

5.14.3 General Considerations

- 1) The ice thickness should be tested before any workers or vehicles are allowed on the ice.
- 2) WEAR an approved life jacket, or preferably, an approved survival suit when testing ice thickness.
- 3) STAY approximately 10 m. (33 ft.) apart. The lead member should wear a safety harness attached to a 1 cm (3/8 in.) thick and about 20 m (65 ft.) long polypropylene rescue rope held by following crewmembers.
- 4) Test ice regularly for repeated work or travel over ice to ensure continued safety.
- 5) SAFE ICE THICKNESS.
 - a) Clear blue ice is the strongest. White opaque ice is the least dense (has air bubbles), weaker than clear blue ice. Gray ice indicates the presence of water from thawing and is unsafe as a load-bearing surface. Saline, sea ice needs to be thicker than fresh water ice. As a general rule 30% thicker is acceptable.
 - b) Ice thickness is determined by the full thickness of clear blue ice plus half the thickness of white continuously frozen ice.
 - c) TEST holes should be cut according to local procedures.

5.14.4 Gold's Formula for Checking Ice Strength

The following chart is for use when travelling or stopped on ice. The chart will specifically allow workers and supervisors to determine load bearing capacity of ice utilizing this formula. **However, reductions in allowable loading may be required due to thermal stress, fatigue, ice quality, cracks, vehicle speeds, snow cover, and load duration. The chart is a guideline, as there are many variables.**

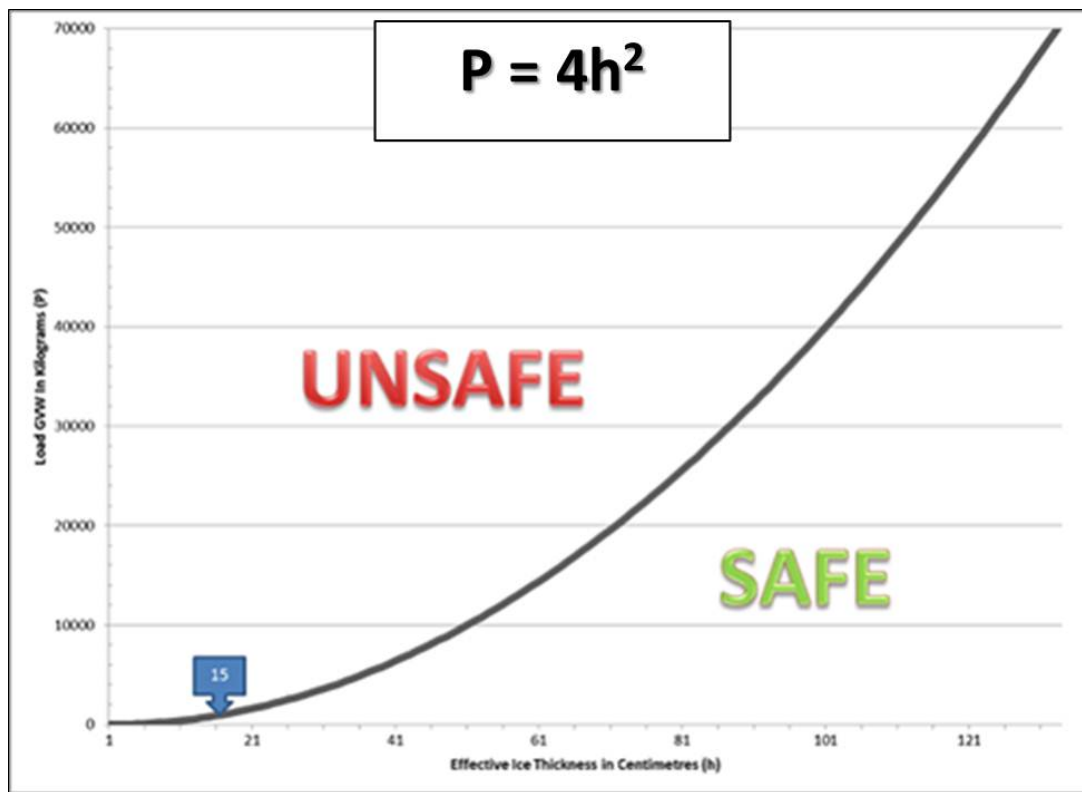


Figure 7 - Ice Thickness Chart

Note: The minimum ice thickness required for any manned vehicle of less than 1000 kilograms is 15 centimetres. (1 kg = 2.2 pounds, and 2.5 centimetres = 1 inch)

This formula works in the following manner:

Where “**P**” is the Gross Vehicle Weight in **kilograms**, and

Where “**h**” is the thickness of the ice in **centimetres**,

The calculation for minimum ice requirements can be made. For example, if the ice thickness is **75 cm’s**, the load that the ice can hold is as follows:

P = 4 times (75 squared)

P = 4 times (75 times 75)

P = 4 times 5,625

P = 22,500 Kg’s

Therefore, the ice at that thickness will hold 22,500 kilograms. You may proceed if the GVW of the vehicle is less than this amount.

If at any time the condition of the ice is suspect, the personnel and equipment will NOT repeat NOT proceed until this has been properly checked by the ice profilers.

5.14.5 Vehicle and equipment

Ensure you know your GVW !(gross vehicle weight): equipment, cargo, people—and your fully fuelled vehicle. Record the GVW and date on a sticker in the vehicle and on equipment. Note - If you don't know the GVW, weigh the loaded vehicle.

Safety equipment in vehicle	What you need it for
axe or ice chisel, ice auger, and air temperature thermometer	measure ice thickness and air temperature
two-way radio, phone (on cellular or satellite service) or other electronic communication device	stay in contact with your team call for help
warning devices (pylons, reflectors, flares, flags)	warn others; close danger areas attract attention in emergency
fire extinguisher	put out vehicle/equipment fires
first aid kit	treat minor injuries
metal or ceramic coffee mug	melt snow or ice for drinking
emergency rations: energy bars/food; hot beverage mixes (instant coffee, tea, hot chocolate)	sustain energy and keep warm
snow shovel	remove snow if vehicle is stuck
sleeping bag (or blankets), backup warm clothing	keep warm and dry
candles, flashlight waterproof matches/lighter, material to start fires	see what you're doing keep warm and signal others

5.14.6 Minimum distances between vehicles

GVW up to 5,000 kg: Distance between vehicles should be at least 200 x *ice thickness*, e.g., on ice 1 m thick, a 4,500 kg vehicle should be 200 m distance from the next vehicle.

GVW 5,000 to 63,500 kg: Distance between vehicles should be at least 500 x *ice thickness*, e.g., a 10,000 kg vehicle on ice 1 m thick, should be 500 m distance from the next vehicle.

Some ice covers are on bodies of water too small to allow for the minimum distance between vehicles. In that case, there should be only **one vehicle at a time** on the ice cover.

If there are no markers to judge distance between vehicles, wait at least 2 minutes before you follow a light truck, if both vehicles are of similar weight and are travelling no more than 10 km/h. At 10 km/h, wait at least 5 minutes before you follow a heavy truck (up to 63,500 kg). In both cases, the ice must have the minimum thickness needed to support the GVW.

5.14.7 Parking a vehicle or equipment

Before you park a vehicle or equipment on the ice cover, check:

- your GVW—Vehicle including fuel, equipment, cargo and people

Check your Ice Safety Plan for:

- maximum time on the ice and minimum ice thickness—fresh or sea ice

For example, a light truck parked for more than 2 hours but less than 7 days requires at least 55 cm of clear, good quality fresh water ice.

- variations in ice thickness—Ice is often thicker in a driving lane, but thinner and weaker near and under snow banks beside driving lanes.
- distance—Park vehicles and equipment at least 2 lengths apart—vehicle plus equipment lengths.

5.14.8 Driving a vehicle on ice

Before driving any vehicle on the ice cover, even a snowmobile, check:

- your GVW—Vehicle including fuel, equipment, cargo and people

Check your Ice Safety Plan for:

- ice thickness—One snowmobile needs at least 18 cm of clear, good quality fresh ice to support GVW less than 500 kg. A light truck (GVW less than 5,000 kg) needs at least 38 cm of ice thickness.
- speed limits—Always drive slower than the maximum posted speed.
- minimum distance between vehicles on the same route
 - > GVW under 5,000 kg stay 200 x ice thickness apart
 - > heavier vehicles stay 500 x ice thickness apart
- special conditions along the route—for example, areas under repair, thin ice caused by river currents, snow banks, or near islands and shores

5.14.8.1 General Guidelines for Operating Seismic Equipment on Ice Covers

- 1) When water is seen coming up onto the ice and it is flooding the area, move away from the hole or crack where the water is coming from.
- 2) If a machine gets stuck in the snow or ice and water is visible in the cracks, get out of the machinery and move away to a safe distance at least 60 feet (20 meters). If the equipment stops settling and you attach a line, make sure the line is at least two times longer than the water depth (measured from the top of the ice to sea floor). Stuck equipment can break through the ice at any time so keep yourself clear of the line, and do not step in coils, or loops.
- 3) If equipment is parked on the ice, allow adequate distance between each unit. Do not park close to, or over a wet crack. Park at least 150 feet (50 meters) away from a wet crack, and never travel along

the edge of the crack. Cross active wet cracks at right angles or perpendicular to the crack. Dry or refrozen cracks are not the concern that wet cracks are.

- 4) The following is an example only of static parking times for vibrators when NO wet cracks are present, and is not meant to replace good judgment or associated research. The example does not refer to dynamic parking (vibrator deploying its source).

<u>Air Temperature</u>	<u>Parking Time</u>
10° F	24 hrs
20° F	6 hrs
30° F	45 minutes

- 5) If the air temperature averages above 40°F for 4 days, consideration should be given to suspend operations on sea ice.
- 6) Equipment should never be parked on the seaward side of islands due to the possibility of ice separation from shore.

Even though the ice sheet is in one piece, the ice temperature is critical, for example:

- 65,000-lbs. per sq. meter is supported by 3 ft. of ice at 10°F.
- 65,000 lbs. per sq. meter at 28°F requires 4 ft. of thickness.

If it takes a minimum of 3.5 ft. of sea ice to support a 72,000-lb. vibrator at 10° F or below at 28°F, it will take 4.5 ft. If you are on the edge of a wet crack, it will take 5.5 ft., of ice at 10° F and 8.5 ft of sea ice at 28°F.

- 7) Move away when you see the equipment in front of you sag or crack the ice. Some sagging and bending can be normal when crossing a wet crack, but not if the seawater comes up out of the crack.
- 8) Remember the ice is floating in seawater. A hole can be drilled through the ice sheet and water will flood the hole to within a few inches of the top. The distance from the water level in the hole and the top of the ice is called freeboard. If a machine is parked on the ice, and a hole drilled through the ice beside the machine has water coming out of the hole flooding the area, then the ice has been overloaded.
- 9) Some snowdrifts are large and heavy and prevent the cold air from growing strong ice. If you drill a hole through the drift and the ice sheet, and water flows out of the hole on top of the ice and into the snowdrift, the ice is overloaded.
- 10) Since deep snow cover can load the ice and push the ice surface below sea level, and cause the sea water to penetrate the base of the snow, slush covered or water covered ice should be avoided.

- 11) High winds and rapid drops in air temperature can crack the ice, especially where the snow has been plowed out recently.
- 12) N.E. winds are prevailing on the North Slope. They typically cause the formations of pressure ridges and tidal surge, which may cause overflow. SW winds can cause open leads in the ice, and can cause dangerous conditions.
- 13) When the snow is plowed into a berm to clear the trail, the snow load is still close by.
- 14) When the trail is plowed out, you can usually see the cracks better. On a plowed or unplowed trail recent blowing snow conditions could have covered wet cracks and hidden them from your view.
- 15) The problem with an active wet crack and a small pressure ridge together, is not so much the main wet crack, but the smaller wet cracks that may or may not be a few feet away and parallel or at an angle to the main crack. The smaller cracks form as the snow load increases around the main crack. If you get between these wet cracks, the already overloaded ice will start sinking with the vibrator or bulldozer.
- 16) Water flowing over the ice is an additional load. The equipment can sink rapidly, in this case, and you will be unable to drive out onto the edge of a solid piece of ice; therefore you should leave the vehicle. If it stops sinking, do not go back into or on the machine.
- 17) “Strings” of vibrators should not be on line vibrating if there is a wet crack in front of the string and a wet crack behind, and the distance between those cracks is 85 meters or less.
- 18) Do not cross wet cracks with the vibrators in a close “echelon shaking” configuration. Spread out before crossing. The vibrators following should study the reaction of the ice as the unit crosses the wet crack. If you see water coming out, more sagging, and maybe more cracking, detour around the area.
- 19) You should not work in high winds with visibility so poor you cannot see the ice and snow surface.
- 20) Vehicles working on ice should stay on designated trails at all times. A minimum safe distance should be maintained between vehicles at all times. Camp Trails and logistics trails should be checked as well as the seismic line.
- 21) Heavy equipment should not remain parked on floating ice longer than 15 minutes.

5.14.9 Ice Profiling & Working Safely on Fresh and Sea Water Ice

Designated crew Ice Checkers should be in place to coordinate with the survey team ahead of all operations and camp moves to ensure that all trails have been checked for ice integrity before crossings are made.

The Ice Checkers are responsible for keeping a log of ice and water depths and for relaying this information to the Survey Department so that hazard mapping may be updated.

Ice drills and ground penetrating radar (GPR) are typically mounted on buggies and are the primary source for checking ice. Electric augurs can be used in places that the vehicle cannot get to or in areas where thin ice is suspected.

When using (GPR) typically a system will be set up to periodically verify the GPR readings – manual drilling with an electric or fuel powered drill is used in this case to check GPR readings to make sure they are accurate.

The ice checkers measure ice and water depth, cracks, pressure ridges, snow drifts, and any suspicious spots that might indicate a change in the ice condition. The frequency of drilling depends on the existing ice conditions. Ice checkers should be trained on drill operations and receive on the job training from experienced ice checkers on what to look for. Any hazards encountered should be marked, and their locations passed along to the Party Manager on the crew. This information will be shared with effected personnel by a number of methods including map distribution, updating navigation computers and safety meetings.

5.14.9.1 Setting up an ice cover (profiling)

If you are the first person on the ice, you should have these safety measures in place:

- an Ice Safety Plan for pre-construction and construction stages of building the ice cover that follows best practices
- ice safety training that includes self-rescue techniques
- a partner who knows rescue and self-rescue techniques

Note that river ice can be more dangerous than lake ice because currents can erode ice and create thin spots.

5.14.9.2 Walking or working on foot

Before you step on the ice, check your Ice Safety Plan for:

- required minimum ice thickness—There should be at least 10 cm of clear, good quality ice before you can walk on it. If you plan to stand in one area for more than 2 hours, the ice cover should be at least 15 cm thick.
- local conditions—Ice thickness can vary a great deal, particularly near shore, around the bend of a river, or near snow banks. If there is open water nearby, you need specialized PPE, ice safety and rescue training.
- type of work—Checking ice thickness requires working and walking in pairs. Both members of the team should wear flotation suits and remain at least 10 meters apart. They should be trained in rescue and self-rescue techniques and use the appropriate equipment for ice testing.
- your team—Do not work alone when taking initial ice thickness measurements or during initial construction of ice covers.

5.14.10 Types of ice on an ice cover

- Clear ice is relatively free of air bubbles and vegetation.
- On any body of water, ice can be thinner and weaker around islands, shoals and shorelines.
- Water currents, heavy snowfall, high winds and sudden changes in temperature can all affect the strength of ice.

Ice type & variation in ice thickness	Ice quality and strength
Blue ice on lakes and rivers	
Freshwater lake ice (blue) <ul style="list-style-type: none"> • thickness varies little over an area 	<ul style="list-style-type: none"> • higher strength due to uniform thickness and quality
River ice (blue) <ul style="list-style-type: none"> • medium to high variation in thickness • more prone to losing underside ice thickness due to water currents 	<ul style="list-style-type: none"> • fairly uniform ice quality • variable load bearing due to variable ice thickness
White ice from natural or manual flooding	
Constructed flood ice (white) <ul style="list-style-type: none"> • good practices yield uniform thickness 	<ul style="list-style-type: none"> • good ice quality due to uniform thickness
Natural flood or overflow ice (white) <ul style="list-style-type: none"> • ice thickness varies greatly • higher potential for water and air pockets that reduce ice thickness 	<ul style="list-style-type: none"> • ice strength varies with variations in thickness • variation in quality due to higher air content
Ice formed over muskeg or peat land	
<ul style="list-style-type: none"> • highly variable over the entire area • surface can quickly change from frozen peat to ice floating on peat • ice cover requires special analysis 	<ul style="list-style-type: none"> • strength varies due to variations in water chemistry, temperature • frost depth depends on air temperature, peat composition, its thickness and ground cover

5.14.10.1 Sea Ice

- Polar Bears inhabit the ice pack. Be alert.
- Sea ice is dynamic; therefore, cracks and pressure ridges are subject to constant change.
- Log any significant cracks. Report any changes in the ice.

- Check the ice on each side of any pressure ridge, and as close to the peak of the ridge as possible.
- If a detour is deemed necessary, check ice thickness and water depth along the detour route and mark the route clearly with survey lath.
- Investigate any anomaly seen in the ice. Check it and log the results.
- When encountering pan ice (a smooth patch amid rough ice) investigate on foot before driving onto the smooth section. In this situation, use a hand portable drill if possible.
- The general thickness of the ice, water depth, and the recommendation of the Party Manager and/or the Vibrator Mechanic determine the distance between holes drilled.

5.14.11 Types of ice cracks on an ice cover

Crack caused by change in temperature & ice thickness	
Dry cracks <ul style="list-style-type: none"> • do not reach bottom of ice cover • caused by ice bending due to weight of load, temperature changes 	<ul style="list-style-type: none"> • crack through $\frac{1}{4}$ to $\frac{1}{2}$ ice thickness: flag area, monitor and repair, record repairs • crack through $>\frac{1}{2}$ ice thickness: flag and close area • report cracks to your supervisor
Wet cracks <ul style="list-style-type: none"> • crack reaches bottom of ice cover, allowing water to reach the surface 	<ul style="list-style-type: none"> • flag and close area to others • report cracks to your supervisor
Crack caused by overloading	
Radial cracks <ul style="list-style-type: none"> • look like spokes in a wheel • a warning that ice is overloaded—load may break through the ice 	<ul style="list-style-type: none"> • immediately remove load from ice • report cracks to your supervisor
Circumferential cracks <ul style="list-style-type: none"> • form a circle around the load • a warning that ice is overloaded—load is about to break through 	<ul style="list-style-type: none"> • immediately make sure everyone leaves the area • report cracks to your supervisor
EXTREME DANGER: Circumferential cracks connected with radial cracks <ul style="list-style-type: none"> • form pie-shaped wedges • ice has failed; if not already broken through, it can do so at any minute 	<ul style="list-style-type: none"> • immediately make sure everyone leaves the area • report cracks to your supervisor

5.14.12 Ice Drilling

At the beginning of the season, the drill or GPR buggies should be checked thoroughly by a qualified mechanic to ensure that all parts of the drill mechanism are in good condition. The drillers should accompany the mechanic during this inspection to become familiar with the maintenance of the drill.

Before the season starts, the drill or GPR buggies should be equipped with the tools that are necessary to perform routine maintenance and repairs in the field. Tools should include wrenches to tighten hydraulic fittings, change drill bits, replace master link if chain breaks, etc.

Journey management practices should include monitoring the radio, reporting in to management at designated times, knowledge of the vehicle tracking systems (GPS) and trip planning.

5.14.12.1 Items Needed

- Drill bits: Carbide-tipped finger bits seem to be the most efficient type. Carry in the vehicle at least two sets of finger bits, preferably three. An extra bit is also recommended.
- A piece of electrical conduit at least eight feet long that can be used to determine ice thickness. The end of the conduit can be bent to form a hook for hooking on the bottom of the ice after the hole has been drilled. The conduit can be marked in six- inch increments.
- A rope, at least 30 feet long for determining water depth. The rope can be weighted with scrap metal that can be acquired from the camp shop. Rope can be marked at five -foot intervals.
- Extra drill flights.
- Survey lath and/or pin flags(if any are available) for marking thin ice, areas to be avoided or recommended detours.
- For operations with ground penetrating radar, the buggy is normally equipped with a “side car” bracket towing a small sturdy “Jet Sled” or similar sled with the GPR unit strapped in and secured.
- Checklist for Pre-Trip Inspection – I.E. Walk around vehicle: check tires / tracks, for any fluid leak, etc., Check fuel level, Look at all hydraulic fittings for leakage.

5.14.12.2 Drilling Fresh Water Ice

- Before raising the drill tower, be sure the drill buggy is parked securely and will not move during the drilling operation. If the vehicle moves while the drill stem is in the ice, undesirable results are imminent. After selecting the location to be drilled, move the steering wheel back and forth a couple of times to stabilize the tires. Articulate the buggy to the left, this stabilizes the vehicle and affords the driller a good view of the drill while it is in operation.
- Maintain high RPM's of the motor while drilling.
- Do not force the drill. If it is not getting through the ice at a steady pace, bring the drill up and inspect the bits for sharpness, flights for straightness, etc. Putting undue pressure on the pull-down chain or banging the bit against the ice may break something or, even worse, result in the bit being stuck in the hole.

- When drilling fresh water lakes, beaver ponds, creeks and rivers try to check the ice close to the banks where the snow has drifted. Sometimes the ice is thinnest close to the bank because the drifted snow insulates the ice beneath, slowing the freezing process. There may also be decay from rotting organic matter near beaver dams that may create thin or rotten ice conditions.
- Crossing a large lake, drill in the deepest snowdrift that is in the path. There can be as much as 6 or 8 inches difference in ice thickness between ice that is uncovered and ice is covered by a snowdrift.
- Log all significant cracks encountered. Any large crack should be drilled on each side to assure that shelving is not present.
- Follow any significant crack to see if it will cross more than one seismic line and to determine if the crack is widening or changing. If a change is detected, check ice thickness and water depth and log it.
- Pressure ridges can be present on large lakes. Drill each side of the pressure ridge and as close to the peak of the ridge as possible.

5.14.13 Portable Ice Drill Safety

- Stay alert, watch what you are doing, and use common sense when operating a power tool.
- Dress properly. Contain loose clothing, gloves and long hair away from moving parts.
- Avoid accidental starting. Be sure switch is in the locked or off position before inserting the battery pack.
- Remove adjusting keys or wrenches before turning the tool on.
- Do not over reach. Keep proper footing and position at all times.
- Use safety equipment. Always wear eye protection
- Maintain tools with care. Keep cutting tools sharp and clean.

5.15 Hour Operations

Night operations require special planning and caution. A thorough risk assessment should be done before any night time operations and if the risks cannot be mitigated to a reasonable level then the work should not be done. These hazards include:

- Security of the recording area
- Explosives flying debris
- Overhead fallout from trees
- Danger of tripping or stepping in a hole, on roots...
- Man lost
- increased chance of incidents including vehicle collision.

Also, evacuation of injured personnel from the line by night is very difficult, particularly in a jungle or remote location. Therefore the recommendation is to eliminate or limit operations at night.

Follow the below guidelines only after careful review.

5.15.1 Land Night Operations

Operations involving the use of explosives at night are, in some countries, restricted by government regulations. In addition, special permits may be required to operate at night. Therefore, before any night operations are initiated, check government regulations or local permit restrictions. If night operations are permitted, following are some guidelines:

- 1) Adequate illumination should be provided for all work groups. Personnel should wear reflective jackets. If you cannot see adequately to perform your work safely, inform your supervisor.
- 2) Plan to perform the work as much as possible during daylight hours. For instance, for night vibrator operations, scout all the planned vibrator points during the day. Buildings, culverts, overhead power lines, etc., could be missed if not scouted during the day.
- 3) The emergency response plan should be updated to include night operations.
- 4) Key positions, such as base camp radio operator, should be manned when work is being conducted in the field.
- 5) Local authorities should be advised of all night time operations.
- 6) No cross country walking should be attempted at night. The danger of tripping or stepping in a hole is too great.
- 7) Special attention should be paid to accommodation (quiet sleeping quarters for night workers), food and fatigue management.
- 8) Scout the area to be worked that night during daylight hours
- 9) Mark all obstacles with reflective tape.
- 10) Have the HSE Advisor, crew medical doctor/nurse standby in the field during recording operations.
- 11) Frequent radio contact with all personnel on the line.
- 12) Head count of all groups at the end of the night work.
- 13) First aiders with the crews at all times.
- 14) All personnel provided with miner head lamps fitted to the hard hats,
- 15) Reflective vests, and appropriate weather gear.
- 16) Only line checkers, shooters, recorders and their helpers will work during night time operations. No pick up or laying out of line will be performed at night.

5.15.2 Boat Operations at Night

The following equipment to be carried on at least one boat in the work area and all supply boats should include:

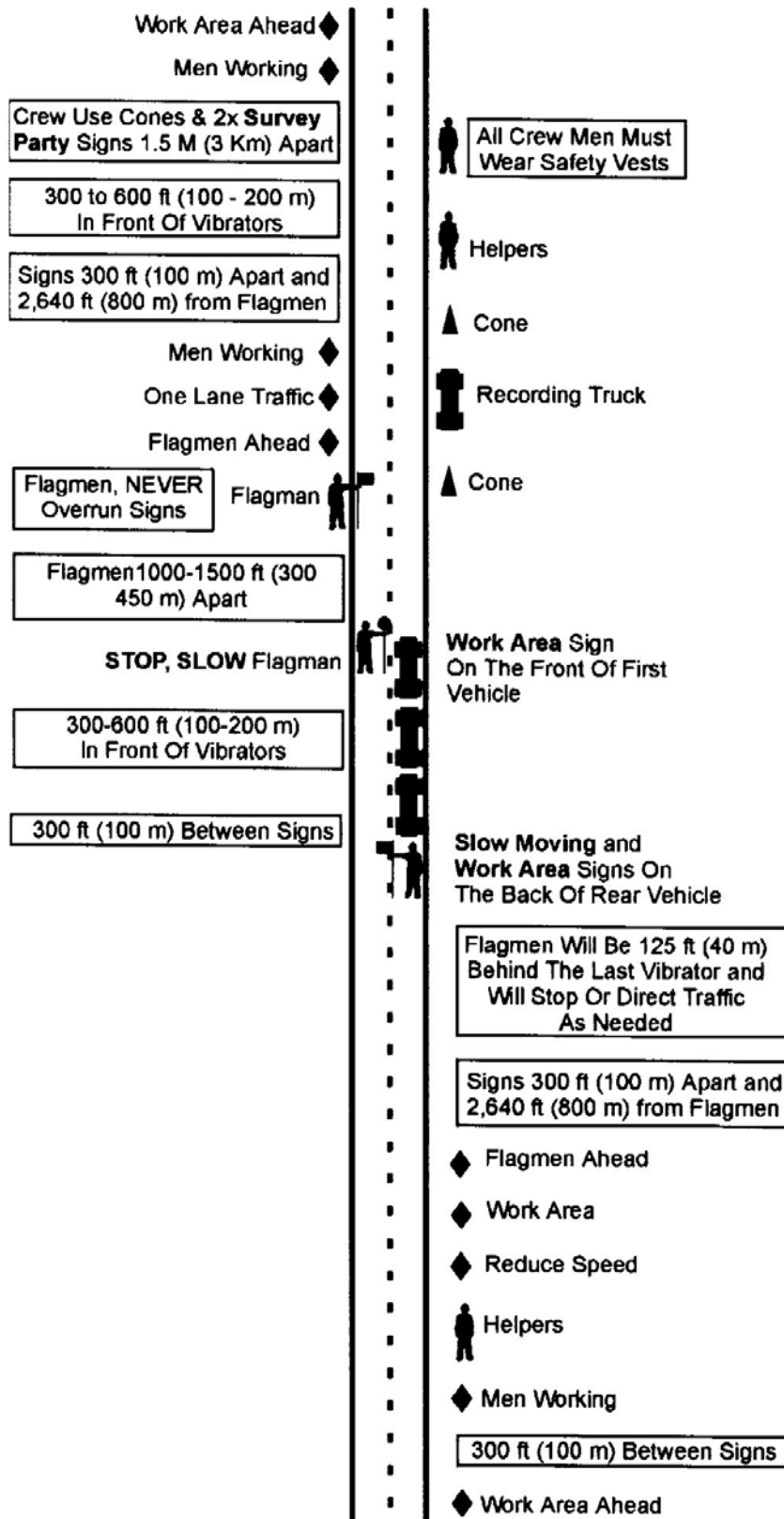
- 1) Radar.
- 2) Two searchlights.
- 3) Fathometer.
- 4) Radio.
- 5) Emergency flares.
- 6) All life vests should have whistles and illumination lights attached. A personnel location beacon should be considered.
- 7) One life ring per crew member or life rafts for the full crew.
- 8) Two emergency flashlights.
- 9) Sufficient lighting to enable clear vision within all areas of the boat where work will be performed.
- 10) All boats involved in night operations should operate under the crew's journey management procedures, and preferably with real time monitoring.

5.15.3 Road Operations

- 1) Good traffic control is necessary to provide maximum warnings to all road users to prevent incidents and promote a continuous flow of traffic (some countries have regulations for traffic control and working on highways)
- 2) Warning lights, flags and signs that meet local regulations and written in the local language are required when working along road and right-of-ways.
- 3) The risks of operating on farm roads and back roads are often greater than those encountered on the main roads and highways. The secondary roads usually have more curves or doglegs, and hills are sharper or more acute than those of main highways. Trees and shrubbery grow closer to the road. If there is a shoulder, it is not always an all-weather shoulder.
 - a) When operating on any public road or shoulder, all vehicles should display regulation warnings. These may be rotating or flashing light beacons or strobe lights. Vehicle warnings should be clearly visible from all directions.
 - b) When operating on any public road or shoulder, each vehicle should have all lights and four-way flashers operating. Vehicles should display red flags and/or slow moving signs.
 - c) Flagmen and all members of the crew working on the operations should wear bright, reflective safety vests and hard hats to enhance their visibility and to distinguish them from other road users.

- d) When one lane of a public roadway is blocked, flagmen should be posted in order to direct traffic around the obstructing equipment. The flagmen should be equipped with two-way radios and with Stop and Go signs, as required by local authorities. Each flagman should be instructed in proper methods of directing traffic, the importance of authoritative and positive traffic control, and proper procedure in emergency situations.
- e) When operating on any public road or shoulder, warning signs should be placed and maintained in both directions of the work area. Appropriate equivalent signs should be used in the local language.
- f) The location, number, size and type of signs will be determined by the speed of traffic, visibility restrictions caused by hills and bends and by local regulations.
- g) If any vehicle is parked on the shoulder of the road, several approved road traffic cones should be placed on the road ahead of and behind the vehicle.
- h) Be aware that noise from equipment may drown the sound of oncoming traffic. Always look both ways before stepping onto the road or dismounting from the vibrator or vehicle. Don't jump out of the vehicle!
- i) Cables crossing a roadway should be passed through culverts. If a cable should cross the surface of a road, it should be placed into a cable protector and secured to the surface of the road-way.
- j) Cables across heavily used highways should be checked often to ensure that they have not become unanchored. Do not work on cables while traffic is crossing the cable.
- k) Avoid suspending cable over a roadway. If the cable should be suspended, be sure it is sufficiently high to allow vehicles, especially tall trucks, to pass underneath. Secure the cables firmly. Put up warning, and possibly speed restriction signs and tie ribbons to the cable to make it more visible.

Minimum Vibrator Safety Requirements For Operation On The Highway



5.16 Tools



- 1) The improper use of hand tools is the major cause of many minor but painful injuries. Use a tool correctly and only for its designated purpose. Replace worn parts such as ratchet cogs, dies, handles and shields. Keep chisels, screwdrivers and punches properly dressed. Dispose of defective tools that cannot be repaired. Use eye protection as required.
- 2) Do not use cheaters on wrenches that are too short.
- 3) All electric hand tools should be either grounded or double insulated. Three-wire cords should be used with grounded tools. Ground Fault Current Interrupters (GFCI's) or Residual Current Circuit Breakers (RCCBs), shall be utilized for tools operated in wet areas. These circuit breakers should be periodically and systematically tested.
- 4) Some tools are designed with protective guards. If the guard has been removed or does not work properly, do not use the tool until the guard has been repaired or replaced.
- 5) Keep machetes sharp at all times and sheathed when not in use.
- 6) Store and transport machetes, knives, brush-hooks and axes in a sheath. Brush-hooks should be used only where practical. All types of knives and cutting utensils should be subject to risk assessment. Strict controls should be applied for the use of razor knives.
- 7) Secure and stabilize all vehicle jacks during their use, add a base plate below the jack. Under no circumstances work under a vehicle supported only by a vehicle jack.

5.17 Firearms



Firearms should not be carried within premises by any person or in any vehicle unless management has issued written permission.

5.18 Archeological

Disturbing an archeological site could have serious repercussions. Archeological sites are generally of historical, religious or cultural significance. If a suspected site is encountered, crew personnel should be instructed not to alter the site in any way. Crew members should not remove any artifacts from the site. Moving rocks constitutes altering the site. The proper authorities should be informed of the location. If a suspected site is encountered:

- Do not damage the site or remove any artifacts
- Note the location of the site
- Mark or tape off the site area to prevent others disturbing it
- Inform your supervisor

5.19 Horseplay

A responsible attitude toward HSE is essential from each individual. All personnel should conduct themselves in a manner conducive to a good working environment for the common good of all.

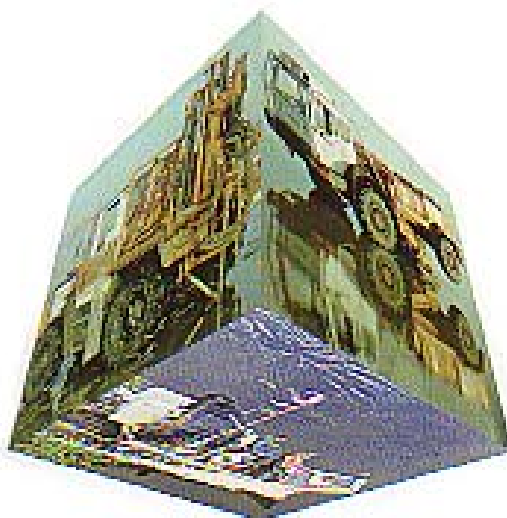
Horseplay may start as a joke but many times it escalates to an uncontrolled situation and may lead to fighting. The geophysical environment has no room for horseplay. Everyone shares a responsibility to see that it does not occur.

5.20 Subcontractors and Visitors

Subcontractor personnel and new visitors will receive HSE orientation prior to joining the crew and they should be made familiar with this manual as far as it is relevant to their part in the operation. In effect, third parties and subcontractors should follow established procedures and the guidelines set forth in this manual, along with any company specific or local regulating agencies.

- 1) It is the responsibility of each person to report any unsafe actions or conditions to the local line manager.
- 2) Personnel joining a land operation should be in good health & medically fit for work. Individuals who may be undergoing treatment, or taking medication or allergic to particular drugs should make this known, in confidence, to the crew medic.
- 3) Personnel should have completed appropriate emergency and survival training courses according to industry standards. This applies to harsh environments such as deserts, arctic climates, and over water helicopter flights.
- 4) All HSE training records, medical examination dates, medication usage and other pertinent information should be available and presented to the local line manager.
- 5) It is mandatory to wear appropriate Personal Protective Equipment (PPE) where posted or if instructed to do so by the staff.
- 6) Upon joining a land operation visitors should submit emergency contact phone numbers (next of kin) in case of an emergency.
- 7) All visitors should check in when arriving on location and check out on departure with the crew manager or via the journey management system. Some locations may require strict adherence of journey management procedures.

6. SEISMIC DRILLING



6 SEISMIC DRILLING

6.1 Drilling Operations



There are numerous types of drill rigs which can be used in seismic drilling including conventional truck mounted, buggy drills, track drills, portable drills of various types, airboat drills, marsh buggy drills, jack-up drills, and mini hole drills. These drills can remove cuttings from the hole by means of water jet/injection, mud circulation, air, or by the use of augured pipe stems. Ram rigs, although technically not a 'classic' drilling machine, is another method for placing explosives into the ground. The type(s) of drill(s) or ram(s) selected for use will depend on site-specific conditions encountered on each job, and will be set out in the contract.

General guidelines, which apply for ALL types of rigs (drill and rams), are as follows.

6.1.1 Planning & Set Up

- 1) Subcontractors should check their client's HSE standards and specifications before project start-up.
- 2) The driller and assistant are the only members of the party designated to operate the rig equipment. No employee should operate the rig in training or practice unless under direct supervision.
- 3) The driller should plan ahead for the job. Problems should be discussed and a safe system agreed upon.
- 4) Rigs and support vehicles, including boats should be equipped with the correct fire extinguishers and fully stocked first aid kits.
- 5) There should always be a second crew member (helper, etc.) at the rig in case of emergency, who understands and can operate all emergency shutdown of the rig.
- 6) Always check for overhead obstructions such as power lines and ensure the rig is level and stable before raising the mast.
- 7) Drilling/ramming should not be carried out on any shot point that has been previously shot or contained explosives.

- 8) The shot hole should not be drilled closer than two times the hole depth from any power line, unless special precautions have been taken for hole blow out. Consider offsets in order to meet this requirement.
- 9) Special hazards around the drilling rig and location should be identified and marked, roped off or blocked.

6.1.2 Maintenance Checks:

Warning: Before beginning any repairs or maintenance, care should be taken to lock out, tag out, block or otherwise protect personnel from moving parts and stored energy, and assure that the drill equipment cannot be inadvertently placed into operation.

- All equipment should be locked out from unintentional movement when not in care and control of the operator.
 - Equipment or Vehicles unit should be in park and shut off when completing any fuelling and/or maintenance operations.
 - During maintenance procedures for pre-start up, equipment and vehicles should be parked with extra clearance.
 - Consider installation of secondary safety features to lockout hydrostatic drive levers when the operator is not in the driver's seat. This safety feature would provide an extra control to the park mode.
- 1) Daily maintenance checks should be performed and any repairs carried out before work starts.
 - 2) Pre start-up check should include guards, fuel lines, fuel tanks and lids, spark plug wires, switches (for proper installation), hoses, safety chains, couplings, oil levels, air filters, fire extinguishers, first aid kit, brakes and steering. The engine stop switch operation should also be checked at the start of each day's operation.
 - 3) Post start-up check should include throttle operation, gauges and hoses for hydraulic and air leaks.
 - 4) Make sure your supervisor or mechanic is advised at once if a rig is not operating properly.
 - 5) Do not attempt repairs, maintenance or service while the machinery is running. If adjustments must be made while the machinery is running, do so only when an assistant is nearby that can take emergency measures in the event of malfunction.
 - 6) All shafts, sprockets, pulleys, gears and other moving parts should be guarded. If guards must be removed, replace them before the machinery is placed back into operation. Do not risk losing a finger or foot by using unguarded machinery.
 - 7) Rigs should be kept leak free. Steps should be taken to keep motor oil and hydraulic fluids from getting to the ground or into the water. Oil spots on the ground should be removed and disposed of properly. Never attempt to stop a hydraulic leak by covering it with your hand.
 - 8) Inspect winch lines, chains and hoists frequently.
 - 9) A daily visual inspection to identify fractures in welding seams, loose nuts, bolts and screws should be performed.

6.1.3 Personal Safety, Safety Equipment:



The driller is the person in charge of all activities & personnel present at the drill site. The driller is responsible for the control of the site, the safety & wellbeing of personnel and ensures compliance with rules and procedures – including the correct use of PPE.

1) Do not wear loose clothing, rings or jewelry around moving machinery or rigs. Secure long hair under head gear. Overalls are the most appropriate form of clothing.

2) Rig crew members should wear appropriate and properly fitted Personal Protective Equipment

(PPE), including but not limited to, steel toe safety shoes, gloves, hard hats, hearing protection, eye and respiratory protection is also recommended.

- 3) Drilling or ramming units should have an emergency shutdown switch fitted in such a way that either the driller or the helper has easy access to it.
- 4) Drilling or ramming units should be fitted with gauges to monitor hydraulic pressure.
- 5) When the mast is being raised, often the lower end of the mast will swing down into contact with the base or skid. This area should be clear of personnel and equipment when raising the mast.
- 6) Once drilling/ramming begins, keep all non-essential people away from the rig.

6.1.4 During Drilling / Ramming:

- 7) Be sure that all holes are being drilled/rammed in compliance with the crew's offset distance table or contract specifications for structures and buried hazards, etc.
- 8) Never drill into explosive materials or into a shot hole that has contained explosive materials.
- 9) Rig personnel should not allow visitors at the drill site who are not equipped with proper Personal Protective Equipment (PPE).
- 10) Never hold or grab a drill bit by the blade.
- 11) Never use the fingers to align the bit and the stem.
- 12) Keep hands and feet away from rotating drill stems. Rotating pipe can cause serious injury to hands, feet and fingers. Use a hand tool to remove cuttings.
- 13) In the event of an approaching electrical storm, stop all operations. Lower the rig mast and move all personnel to a safe distance from the explosives magazines.

6.1.5 Hole Loading, Explosives:

See explosives section of this manual for additional detail regarding handling of explosives in the field

- 1) Follow all safety procedures as recommended by the manufacturers of the explosives and detonators.
- 2) All employees working with explosives should be trained in proper handling, transportation, use and storage. Always minimize the numbers of people exposed during shot hole loading.
- 3) Both explosive and detonator day boxes should be made to regulatory standards of the country and be kept secured. Transport units will display the proper signs at all times when transporting explosives.
- 4) Make sure the detonator wires are properly shorted before loading operations begin. Detonators and explosives should be kept separate (minimum 30m = 100 feet) until priming.
- 5) Some soils cave in easily and make it difficult to keep the shot hole open. Where the shot hole must be loaded quickly, do not rush or forget the basic safety rules.
- 6) Never prime or make up a charge prior to completion of the shot hole. A charge is considered primed when it has been fitted with a detonator. ALWAYS wait until you are ready to load the charge into the shot hole before inserting the detonator into the explosive. Primed charges should be loaded immediately.
- 7) Never place or hang the detonator wire spool on the drill rig while loading the shot hole. This practice may cause static build up and the premature detonation. Always hold the spool by hand.
- 8) Never prime a charge and leave it lying around the rig site, work area or work deck.
- 9) ALWAYS use a blasting galvanometer to check a detonator. Do not use a Volt-Ohmmeter or other device not designed to check electric detonators.
- 10) Before testing a detonator, ensure that the detonator is in a safe place before un-shortening the detonator wires to test.
- 11) ALWAYS short the detonator wires immediately after checking the circuit.
- 12) Never use a radio or any kind of radio transmitter when handling explosives. This includes, but is not limited to, Global Positioning System (GPS) stations, FM (Frequency Modulation) or CB (Citizen Band) radio transmitters and any other electrical device, including cell phones, GPS units, watches, MP3 players, batteries.
- 13) Loading poles should be tipped with non-sparking material (brass, bronze or rubber).
- 14) After drilling and loading the shot hole, backfill (tamp) it with cuttings or another authorized material. Avoid adding the backfill too quickly as this can cause bridging (blockage) in the shot hole. Place a shot hole plug near the surface as per local regulations to avoid wash in.
- 15) Tamping or back filling personnel should never leave the area until the hole(s) have been tamped sufficiently such that the charges cannot be removed from the hole.
- 16) Do not attempt to load a shot hole if water is flowing from it. Attempt to plug it and immediately notify the Party Manager.
- 17) Explosive handlers should not wear synthetic clothing which can generate static. Cotton coveralls are recommended.

- 18) Explosives in field inventory control - Explosives returned by the drill at the end of the day should be counted and checked in the field against amount of explosives issued to each drill and daily production for each drill.

6.1.6 Shot Point Completion and Clean Up

- 1) Do not leave any refuse at the rig location. Do not burn trash at the location. Remove it for proper disposal.
- 2) Do not drill shot holes or ram charges deeper than the limit set by the regulations or the permit.
- 3) Before moving, always visually inspect the machine for dragging items, loose articles, proper equipment, etc. Be sure spare equipment, pipe and tools are secure.
- 4) If a rig is backed up, a helper should act as a guide and, if necessary, stop traffic to ensure that the maneuver is carried out safely.
- 5) Before moving a rig to a new location, always shut the drill engine off if it is separate from the vehicle engine.
- 6) Do not move a rig with the mast raised.

6.1.7 Moving to the Next Drill Point

The process of moving the rig to the next drill point has proven to be a factor in the causes of a number of serious incidents, including rig roll overs, damages to pipelines/power lines, serious permit violations and excessive environmental damages.

It is not recommended to transit with the drill mast up. If it is unavoidable, the route should be well scouted with particular attention paid to overhead hazards (electrical power lines, aerial pipelines, overpasses, etc).

Every point below has been a key factor in a serious incident when ignored.

- 1) Ensure you know the Permit restrictions for the area / shot point you are moving to. They can change if the next point is on another land owner's property.
- 2) If terrain is hilly, uneven or has many ground obstacles (such as deadfall) it is important to check the route ahead to understand in advance the nature of hazards and ensure the route is safely passable. Walking & scouting the route ahead and the use of a spotter when making maneuvers will be prudent and can prevent unfortunate events such as rig roll overs.
- 3) Know the project vegetation clearance rules. If vegetation is too thick and beyond your capability to clear, call in the support of a properly trained brush cutting crew.
- 4) Use existing Flagged Access. There is usually a good reason why a particular route is designated. Do not take new paths or create new trails. If there is a problem with the existing approved access route, contact the surveyors and/or permit agent for assistance.
- 5) Do not ride on drills or support vehicles/buggies to next point unless there is a proper seat with seat belt. There should be proper seating for each person on riding in/on any vehicle or rig.

6.2 Instructions for Specific Rig Types

6.2.1 Truck Drills

- 1) There should be a support vehicle at or in contact with the drill location to be used in case of emergency.
- 2) The mud pit, return ditch and sump hole should be filled in immediately after a shot hole has been drilled.
- 3) Truck rigs may be relatively large and powerful, with high masts and heavy pipes and bits. Awareness of overhead hazards and the potential for falling equipment is crucial.
- 4) If the rig has special pipe handling winches and lines, these will swing equipment overhead and are susceptible to failure. Never get into a position where you are under pipe handling lines or behind the pipe rack when pipe is being lowered. Drill should not allow personnel to carry out activities in this special hazard area.

6.2.2 Track Drills & buggy Drills

- 1) Extreme care should be taken when operating these in hilly terrain. Side hills should be avoided, even on seemingly gentle slopes. Always approach slopes going straight up or down the slope.
- 2) Buggy Drills are often “articulated” (have a pivot point at the center of the machine to enable turning), and the lateral handling and stability characteristics of these change greatly when turning. If on a side hill, they become susceptible to roll over.
- 3) Tracked equipment is designed to have very good traction and handling when moving in forward and backward directions. The tracks do not grip well laterally, making the units subject to sideways slippage and roll over if traversing a side hill. Additionally, the equipment is susceptible to side slip if crossing logs and other deadfall on the ground, even on seemingly very gentle slopes.
- 4) Should a tip over or roll over occur with this equipment, it is crucial that the driver remain inside the cab. Seatbelts SHOULD be worn at all times and the cab should be fitted with a protective roll cage that will keep body parts inside the cab.

6.2.3 Portable Drills and Mini Hole Drills

- 1) Before starting drilling, discuss how you are going to keep the cuttings away from the shot hole. A dust deflector, shovel or rake may be used. Never use your foot or hands to remove dirt while drilling.
- 2) Make sure the area around the drill location is level and clear of obstructions. A platform may need to be built for portable drills.
- 3) Only approved containers for fuel can be used and should be properly marked as to their contents. These containers should be kept away from portable magazines carrying explosives and detonators.
- 4) Fuel tanks should be mounted away from hot parts of the engine or other ignition sources. Where this is not possible, only metal fuel cans with explosion preventers fitted into the spout should be used.

- 5) Where fuel tanks are mounted to the drill, engines should be switched off before refueling. Care should be taken to avoid spills.
- 6) When an air drill is being used, the air pressure should be completely released before breaking any line or connection. Check the gauge. Do not use your hands to check an air stream.
- 7) Air hoses should have the appropriate safety clip connections
- 8) People Portable Drills & Wagon Wheel Drills are taken apart and carried by people from drill location to drill location. It involves carrying awkward machinery and supplies through all terrain, vegetation, muddy, slippery conditions. It is important to have enough personnel at the site to safely carry the equipment without over-exertion (see lifting and handling section) and ensure that there is good footing.
- 9) With Wagon Wheel Drills the down hole & up hole pressure/force required for drilling the hole and removing the pipe is provided by 5-6 personnel who grasp a wheel like handle around the drill machine. It requires personnel to push & pull the rig throughout the full range of motion throughout the day. Care should be taken to ensure there is enough manpower at the rig to handle the activity and proper lifting techniques should be observed.

6.2.4 Heli-portable drills



These are moved from point to point by helicopter by long line (see helicopter section, long lining) and typically these operate in areas with limited access, heavy vegetation, and steep terrain.

When landing drills, beware of falling tree limbs, fixed obstacles on ground (boulders, trees, other equipment)

Rig set-ups on steep terrain may make equipment at site susceptible to roll over downhill. Ensure that equipment and machinery is placed in a stable position.



During drilling on steep terrain, care should be taken to ensure that the rig does not slide, causing the rig to become misaligned with the bore hole and placing the pipe-string in a bind downhole.

Sometimes heliportable rigs must be assembled on site using the helicopter to move parts into place. Beware of pinch-points between machinery components on the ground and machinery components being maneuvered into place. Watch your

fingers!

6.2.5 Marsh Buggy Drills and Pontoons

- 1) Personnel will board and exit only in areas which have been equipped with handrails and steps, climb and descend backwards facing the marsh buggy. Use caution walking on buggy tracks, they become slippery.
- 2) Be sure the tracks are clear of personnel and other equipment before putting the buggy into motion.
- 3) Be sure equipment is secure before crossing levees and canals. If possible, unload passengers first.
- 4) Follow all field HSE procedures and line sketch information when operating the buggy. Do not drive buggy off line without permission.
- 5) Personnel riding on the buggy should use extreme caution. Sit only in designated areas and not on the engine cover, fuel cans, back hoe, etc. Remain seated at all times when the buggy is moving. Obey the instructions of the operator.
- 6) Always wear Personal Flotation Devices (PFDs) when the buggy is in the water.
- 7) Keep deck and drill area clean of greases and other slippery substances.
- 8) Keep fuel in proper containers in a safe designated area.
- 9) Never jump from the buggy to the ground.
- 10) Back up alarms should be operational.

6.2.6 Airboat Drills

- 1) Check props on a daily basis for stress cracks, chips or nicks.
- 2) Drill boat should be kept free of unnecessary debris, which could go into the propeller(s).
- 3) The front deck and work area should be kept clean and orderly.
- 4) Never enter the cage without disconnecting the battery cables, removing the keys and fouling the Propeller (LOTO procedure)
- 5) Shut off engines before refueling.
- 6) When working or traveling over water, personnel should wear proper Personal Flotation Devices (PFDs).

6.2.7 Ramming Rigs

The ram is a piece of equipment designed for planting explosive charges and seismic geophones into the marsh or swamp for acquiring seismic data. The ram may be mounted on a jack-up barge, marsh buggy, air boat, pull boat, or any type of vehicle capable of supporting it. As with all mechanical equipment of this type, failure to operate the ram properly could cause injury to you and to others in the general area.

- 1) When working or traveling over water, all ram personnel should wear correct Personal Flotation Devices (PFDs).
- 2) Make sure that the seismic charge is securely attached to the anchor point before starting the ram operation.

- 3) When the seismic explosive is nitro-based, always ram a dummy hole before ramming with the explosive charge.
- 4) In a new area or one that is known to be problematic, a dummy shot hole should always be rammed first to determine what depth the ram will penetrate to. Some clients insist on a minimum hole depth and, in problem areas, the only way to be sure is to ram a dummy shot hole.
- 5) Do not start ramming operations until procedures are in place to identify whether the charge has become stuck in the ram tube. Procedures should also be in place to deal with a lodged charge safely.



6.2.8 Jack Up Rigs

This equipment is typically used in water and you may need to refer to the IAGC Marine Manual for guidance related to water hazards. There are many hazards specific to this type of equipment. The scope of this manual will focus on drilling & platform operations hazards in association with these rigs.

Jack-up vessels are marine type vessels, and should be equipped as such (e.g. with running lights, a basic navigation system, radios, signaling

gear, emergency flares, first aid kits, life rafts etc.), and people should be adequately trained in the use of this equipment. Inspections should be conducted to ensure all of the required equipment is functional and fit for purpose.

Jack up rigs are essentially a boat or vessel with 3-4 tubular steel legs, each controlled by a hydraulic jacking motor or mechanical ratchet style, that can be lowered into the water to the bottom and then the entire rig/boat can be jacked up out of the water. They then become a type of small drilling platform. Normally the vessels will be jacked clear of the water surface to a nominal safe air gap, accounting for height of tide & surf if applicable, then conduct drilling operations in shallow water.

An adequate JSA and risk assessment should be carried out to cover all aspects of the jack-up operation, including the raising and lowering of the legs.

The vessels should operate in daylight only. At the end of the working day the vessels will be marshaled at a safe location, secured and left unmanned overnight. To ensure that the moored jack-up barges remain in safe condition overnight, they should be well secured (anchored or spudded down) and

supervised. If necessary, a watch craft could be deployed. How this is done would depend on where the craft are secured, security issues, whether they can be managed from a mother boat, etc.

Jack-up rigs have specific stability characteristics and should only be operated by a competent coxswain.

A matrix or manual of permitted operations (MOPO) should govern operations given the weather limitations and sea state that the rig is designed to work in safely. These limitations should be followed closely.

Inclement weather plans should be developed, and limits set as to when drilling, explosives handling and navigation may be compromised. These plans should describe how the jack-up barge is to be secured in rough weather (e.g. run to shallow water and lower the legs, anchor and so on)

A support craft should be considered when planning jack-up operations, for both operational convenience and safety support.

Sturdy side rails should be installed for safety when working on deck.

Approved life vests should be worn by all occupants when the jack-up barge is in transit, or in rough weather, or when personnel work outside the safety rails.

During drilling operations and with the jack-up barge safely secured (spudded in), personnel directly involved in the drilling should remove their life vests to avoid loose straps and buckles becoming wrapped up in the rotating machinery

Jack-up barge specific emergency response plans should be developed and exercised for at least man-overboard, fire and vessel abandonment.

Whenever personnel are working on or navigating jack-up barges, a 24 hour manned radio room / watch will be maintained at the shore camp or offshore “mother vessel”. . An hourly report is to be made by VHF to the Radio Room confirming all vessels are secure. If required, the Radio Operator will initiate a response and call out staff to provide support. Additionally there may be a requirement (depending on conditions) to fit GPS / radio vessel tracking systems on rigs.

When in transit to base or between drilling points, the operator should not keep a drilling pipe in position connected to the motor on the drilling mast. All pipes should be on the rack, stowed & security properly. Additional equipment, tools, and supplies on deck should also be secured before travel.

Space on a jack-up barge is limited. Type 3 day magazines conforming to the Institute of Makers’ of Explosives (IME) standards (Safety Library Publication 1) should be installed and be well anchored to the jack-up barge to avoid them coming dislodged in rough seas.

Strict procedures for safe handling of explosives should be observed (i.e. keep detonators and explosives in their magazines and separated until a hole is ready to be loaded, and only remove and handle the amount required. Discharge static before handling detonators to the barge hull. Keep detonators

shunted until the explosives are in the hole. Keep personnel not involved in hole-loading as far away from the hole and explosives as possible).

Some key items to consider when planning & conducting hazard-risk assessment are provided below:

- Limited working space
- Fall Protection issues
- Wet, Slippery Surfaces
- Floor Openings: Particularly near the drilling area
- Overhead Protection from falling objects
- Special Hazard Areas, Prohibited areas should be identified
- Fuelling procedures
- Fire Prevention & Firefighting: Planning, escape and potential abandonment of the platform
- Hot Work Permitting
- Hazards while jacking the rig up: cranks and ratchets, leveling and balance

7. ENERGY SOURCE



7 ENERGY SOURCE

7.1 Explosives

7.1.1 General

To establish and maintain the highest safety standards in the handling of explosive materials, all phases; transportation, storage and use - should be accorded the same degree of consideration. Everyone involved with any aspect of explosive handling should be adequately trained.

During any operation where explosive materials are handled, a qualified person should be responsible for establishing and enforcing procedures to ensure that all safety precautions and regulatory requirements are being followed.

Personnel involved in explosive handling (magazine keeper and magazine crews, truck drivers and helpers, blasters and loading crews) should be familiar with the characteristics and hazards of the explosive products they are handling (see MSDS) and trained in the proper handling procedures.

7.1.2 Transportation of Explosive Material (Not Including Aircraft)

For this subsection, “transportation” means only the transportation of explosives between the user’s storage facility and the work location and between work locations. Use the local language on all safety signs.

- 1) Do not smoke, carry matches, fuel, flame-producing devices, firearms, or loaded cartridges while in or near a motor vehicle carrying explosives. This prohibition against firearms does not apply when they are required and authorized to protect the security of personnel and the explosives.
- 2) All transportation units carrying explosives shall only be driven by, and be in the charge of, a licensed driver who is physically fit. The driver should be familiar with regulations governing the transportation of explosives in the country or area of operations.

Do not carry or transport explosives in or upon public transport.
- 3) Vehicles used for transporting explosives should be strong enough to carry the load without difficulty, be in good mechanical condition and periodically inspected. Diesel fuelled vehicles are recommended.
- 4) Electric detonators may be transported on the same vehicle with other explosives provided they are segregated and carried in an approved detonator container.
- 5) Explosives may be transported on vehicles carrying equipment (i.e. drills) or materials (i.e. water), provided that the explosives are carried only in approved magazines securely mounted on the vehicle and that while on public roads, the magazine and separate detonator box are closed and locked. Local regulations should be complied with.
- 6) Explosives may be transferred from one vehicle to another within the project area without notifying authorities, provided that the transfer is made under qualified supervision and not in a

congested area or near a public road, inhabited building, operating equipment, or any kind of loading or shooting operation.

- 7) When explosives are transported by a vehicle with an open body, they should be in the original manufacturer's containers, protected against sparks and moisture with a fire-resistant tarpaulin and lashed securely in or on the vehicle.
- 8) All transport used for transporting explosives should be marked or have signs on both sides, the front and the rear. The signs should signify the class of explosives being transported, unless local government regulations require alternative identification procedures.
- 9) Each vehicle used for transporting explosives should be equipped with a minimum of two functional fire extinguishers in separate locations. The driver should be trained in the use of, and know the location of the extinguishers on the vehicle. The vehicle should also have a first-aid kit, tool kit, etc. Radio communications should be made available in an escort vehicle only.
- 10) In the event of breakdown or collision, the local fire and police departments should be promptly notified. (see journey management procedures) Explosives should be transferred from the disabled vehicle to another only when qualified supervision is provided.
- 11) Transport containing explosives, blasting agents, or blasting supplies should not be taken inside a garage or shop for repairs or servicing.
- 12) Vehicles transporting explosives shall avoid congested areas and heavy traffic. Routes for hazardous materials through congested areas that have been designated by local authorities shall be followed. Do not stop or park your vehicle in villages or towns.
- 13) Do not leave any vehicle transporting explosives unattended at any time.
- 14) Explosives or blasting agents not in original containers should be placed in a suitable container when they are transported manually or by pack animal.
- 15) Detonators and other explosives should be carried in separate marked containers when they are transported.
- 16) Do not transport explosives manually or with pack animals during sand, snow, or electric storms, or any time where there is a high static electricity condition.

7.1.3 Storage of Explosive Material

For this subsection, "storage" means storing explosives and blasting agents in storage facilities under the control of the user. Consult local authority for safe distances to store explosive lightning protection and grounding requirements.

- 1) Store explosive materials in approved facilities as authorized by the agency having jurisdiction in the country of operations.

- 2) Do not store damaged explosives with other explosives, or store primed explosives. Contact the supplier to dispose of damaged explosives. Damaged explosives should be safely destroyed according to the manufacturers' recommendations.
- 3) Detonators should be stored separately from all other explosives materials. Primers, detonating cords and boosters can be stored with other explosives, but should not be stored with detonators.
- 4) Magazines and the use of explosives should be in charge of a competent person who should enforce all safety precautions. This same person should be in charge of inventory. The inventory should be up to date at all times. It is recommended that crew management make additional inventory.
- 5) Keep the area around a magazine clear of any combustible material for at least 15 m (50 ft.).

7.1.4 Use and Handling of Explosive Material

All explosives are dangerous and should be carefully handled and used following approved safety procedures either by or under the direction of competent, experienced persons in accordance with all applicable federal, state and local laws, regulations and ordinances. If you have any questions or doubts about how to use any explosive product, do not use it before consulting your supervisor, or the manufacturer. In the event that there are variations between local, state and federal laws, the more stringent obligation or restraint should be exercised. The prevention of incidents depends on careful planning and the use of proper procedures.

The use of charge anchors and shot hole plugs should be reviewed at the planning stage.

- 1) Only authorized personnel who have received proper training may handle or use explosives. Never use explosive materials unless completely familiar with safe procedures or under the direction of a qualified supervisor. A license to handle explosives may be required under local regulations.
- 2) No person may handle or use explosives when such handling or use constitutes a risk. All persons in the blast area should wear the proper protective devices, such as hard hats, eye protection, and ear protection. Minimize the numbers of people in the blast area. Only those necessary to carry out the work should be present.
- 3) No equipment, persons, or activity other than that required for loading shot holes with explosive materials are to be near the shot hole at the time of loading.
- 4) Any knowledge of theft or loss of explosive materials should be reported to the supervisor who, in turn, should promptly notify the proper local and national authorities.
- 5) Never fight fires involving explosive materials. Remove yourself and all other persons to a safe location and guard the area from intruders.
- 6) Always follow the manufacturers' recommendations for the use of an explosive material.

- 7) All tools, machines, equipment, or devices used with explosive material should be designed for use with explosive materials and be checked or tested periodically to ensure that they function properly and in accordance with the manufacturer's recommendations. The mix of electric detonators and electronic detonators in the same area may lead to incompatible blasting units being connected to firing lines, triggering shots during the line test.
- 8) Do not detonate explosive materials in congested areas or in close proximity to any structure, railroad, highway, bridges, power line, communication line, pier, dock, vessel, or other installation that may be damaged.
- 9) All persons in the vicinity of the shot hole should be able to hear, see, or otherwise be aware of any order, warning, or hazardous situation during loading or shooting operations.
- 10) When loading shot holes with more than one loading crew, the crews should be separated by enough distance to ensure safe operations.
- 11) Never drill into explosive materials or into a shot hole that has contained explosive materials.
- 12) The loader should check the shot hole before loading to ensure that it is open to a safe depth.
- 13) Never tamp explosive materials with metallic devices, except jointed non-sparking poles with non-ferrous metal connectors.
- 14) Always insert detonator completely into the receptacle incorporated in the charge as furnished by the manufacturer.
- 15) Procedures should be in place regarding who should be contacted in case of flowing shot holes.
- 16) Be sure that all the shot holes are being drilled in compliance with the crew's offset distance table for structures and buried hazards as per regulations and client guidelines.

7.1.5 Shot Firing

Before detonating any explosive, ensure the safety of employees, the public and property by following all local regulations and these guidelines.

- 1) The shooter should at all times be in control of the shot point area and should be at a safe distance away from the shot point before initiating the firing sequence.
- 2) The distance that the shooter should set up away from the shot point would ordinarily depend on charge size, charge depth, the terrain, ground and soil make up and overhead hazards while taking into account the proximity of trees and any dead limbs. The minimum safe distance is 30m (100 feet) or greater as per risk assessment. This is provided the shooter can see and control the shot point.
- 3) If the shooter cannot see or control the shot point using the above guidelines, then the shooter should adjust the distance as necessary, but never less than the pre-determined safe distance (>30m), until control is achieved. In heavily forested areas, for instance, personnel should be stationed on all sides of the shot point and at the safe distance to prevent people or animals

from approaching the shot point unexpectedly. Where possible the shooters should preferably be located uphill.

- 4) The shooter should know the size and depth of the charge, how the shot hole is tamped or plugged, the proximity to power lines or any other structure or installation, and the presence of any persons within the vicinity of the shot point.
- 5) Personal Protective Equipment (PPE) should be worn by the shooting crew according to crew regulations.
- 6) The firing line should be kept shorted until the shot is ready to be fired.
- 7) The connection should be carefully made; all wires should be well insulated and in good repair.
- 8) Blasting units should be able to deliver current in excess of that required to fire all detonators in the circuit. Use only series circuits.
- 9) Test the blasting unit using the procedures recommended by the manufacturer to determine that the unit can deliver power at the rated capacity. A daily test is recommended.
- 10) The shooter will determine when he is ready on the shot point, but the shot signal may be provided remotely from the recording instruments. The shooter will be in control of the shot at all times. If a remote device is used, the blasting unit should have at least one "dead man" type switch that the shooter must close to complete the circuit.
- 11) Before a shot is fired, the person in charge should give a loud warning signal.
- 12) When shooting near an electrical line or any other utility line (e.g. telephone, or cable), and regardless of whether it is energized, the firing line should be anchored to avoid coming loose and making contact with utility lines. The shot should only fired if it can be done safely.
- 13) When shooting near an electrical line or any other utility line, the shooter should be set up at 90 degrees to the utility lines

7.1.6 Land Surface Shooting

The shooter and his crew should follow the guidelines outlined above and, in addition, follow those that appear below.

- 1) The minimum safe shooting distance for surface shots will depend on the charge size and terrain.
- 2) Employees working in the shot area should wear hard hats and should be provided with approved hearing and eye protection devices and should wear them at the time of the detonation shot.
- 3) The supervisor should monitor and enforce the use of Personal Protective Equipment (PPE) provided to the employees.
- 4) Employees should be instructed in the hazards that exist in surface shooting techniques and a warning system should be established.

- 5) Before any surface shooting begins, a plan should be made and approved by management and client detailing:
 - a) Type and amount of explosive used, including fire retardant characteristics.
 - b) A pattern diagram.
 - c) The method of operation.
 - d) HSE requirements including sympathetic detonation prevention and safe shooting distances.
 - e) Aircraft operations.
- 6) Procedures to ensure the safety of employees, the public, livestock, wildlife and property should be established prior to any implementation of surface shooting techniques using explosives.
- 7) Shooter and shooter's helpers should be aware of overhead fallout from trees, cliffs, or rocks resulting from the shot. Stay up slope of the shot point in case there is landslide of loosened rocks.
- 8) Prior to layout of explosives, each employee should be assigned a specific duty and instructed to adhere to the planned procedure. Should that procedure be altered in any manner, the person in charge of the layout operation should be notified of that change, and all members of the layout crew should be made aware of that change. (management of change procedure) The altered procedure should be checked to ensure that additional hazards have not been introduced, and if so they should be correctly managed.
- 9) Only qualified shooters and helpers designated by the supervisor may be allowed to prime explosives and then only when instructed by that supervisor.
- 10) Minimum safe distances should be maintained between persons handling explosives or exposed charges and any transmitter.
- 11) The shooter should have complete control of the shot detonation. The shooter ,should be able to, at any time, abort the shot due to any abnormality at the shot location.
- 12) Communications between the shooter, explosives handling crew and all other members of the crew should be established prior to detonation in order to eliminate any chance of anyone entering the shot area. All crew members should report the presence of any non-crew members seen in the project area. The shot should not be detonated until the shooter is completely satisfied that the area is secured.
- 13) If the initial shot pattern is not visible to the shooter, guards or observers should be positioned to have clear visibility of the shooter and the shot area.
- 14) A signal of sufficient audible level to be heard within the area of the shot pattern should be sounded before each shot.

- 15) No employee may enter the shot area after detonation until the shooter or person in charge gives permission to do so.
- 16) All permit stipulations concerning crew conduct and clean-up operations should be strictly enforced.
- 17) Proper firefighting equipment should be available to the shooting crew. Crew members should be trained in the use of the firefighting equipment.
- 18) The shooting crew should check behind them frequently for fires.
- 19) A cleanup crew should pick up all the trash. Their search width should be adequate to find all debris. This group should also carry fire-fighting equipment.
- 20) Radios should not be used in vehicles carrying detonators and explosives. Also radios should not be used in the storage areas for these materials.

7.1.7 Misfire Management

The CAGC Best Practice on Misfire Management below should be used as a guideline. Reference <http://www.cagc.ca/> Note that membership is required to view material published by the CAGC.

Local state and country regulations may supersede the guideline below and should be taken into due consideration and complied with at all times.

7.1.7.1 Misfires

Misfires should be dealt with as promptly as possible to eliminate the potential hazard of any misfired hole being accidentally initiated. A thorough risk assessment should be conducted to determine the safest, most effective way to deal with the misfire.

Since misfires occur under varied conditions and are caused by different factors, it is impossible to offer detailed instruction to cover every situation. Due to the potential hazards involved, only persons who are certified, trained and experienced in the use of explosive materials should handle misfired charges.

If a misfire occurs involving the use of an electric or electronic detonator, ALWAYS wait the required regulatory time before entering the 30 meter safe zone to check the hole. (IME SLP4 (2009) and Orica, recommend:

Wait for at least 15 minutes (electric detonators) or at least 30 minutes (electronic detonators) before approaching a misfired shot, unless the manufacturer recommends additional time before returning to the shot-hole.

When the hole is checked, do the following:

- 1) Disconnect the firing line from the blasting machine;
- 2) Shunt the leg wires;
- 3) Secure the blasting machine.

Following the regulated waiting period, the blaster and the absolute minimum number of competent, experience personnel required to assess the situation may approach the misfired hole.

Some of the more frequent causes of misfires are:

- Improper loading practices;
- Damage to leg wires of electric detonators;
- Improper electric connection;
- Insufficient or excessive electric current

The safest and surest way to dispose of any misfired explosive material is by detonation (providing there is sufficient burden or cover to contain the blast). Before taking any such action the following should be observed:

- Have the blaster make an evaluation to determine the amount and location of any misfired explosive material and the condition of the ground surrounding the misfire;
- Have the blaster check the electric detonator circuit using an approved galvanometer. Misfires attributable to malfunctions of the electrical circuit may be reconnected and fired if the holes have sufficient burden. If more than one hole fails to fire, the problem may be the failure of the blasting machine. In this case, the detonators may still be functional and the holes can be re-fired;
- If detonating cord is involved in a misfire, check any lines coming out of the hole and if they appear to be intact, reconnect them and attempt to re-detonate the misfired hole;
- If a hole has not detonated, there will still be explosive materials in the hole, which can be re-primed and fired. If the shot hole is open, it may be possible to place a fresh charge on top of the existing charge in the hole;
- In holes where the cuttings have been removed and the shot hole is open and accessible, a new charge can be placed in the hole and the hole re-fired;
- Never drill in a shot hole that was previously loaded with explosive materials. Initiation can occur if unexploded material is struck by a steel drill bit or stem;
- Never extract or attempt to extract, a detonator or any explosive material from a loaded shot hole;

A thorough investigation should always be conducted of all misfire incidents so the cause can be determined and corrective action can be taken to prevent recurrence.

7.1.7.2 Abandoning A Misfired Charge

If following a thorough risk assessment the results determine that the misfired charge cannot be safely detonated, that it is located in an isolated location, and will not pose a risk to the area where it is located, the charge may be abandoned. If these conditions are not met, contact explosive company experts to assist with further steps that may be considered for removal and/or destruction.

All regulatory requirements regarding abandoning misfired charges should be followed in the abandonment process.

Basic requirements for abandoning a misfired charge include but are not limited to:

- The detonator lead wires should be cut and placed in the drill hole beneath the surface;
- The surface should be covered with drill cuttings;
- A Lost Hole Marker may need to be placed in or beside the shot hole;
- Lost Hole Markers are normally available through local explosive suppliers;
- The Employer should keep a permanent record of the misfire, including information on the location, explosive type and depth;
- Required reports should be submitted to appropriate regulatory agencies..

7.1.7.3 Proximity to Pipelines

If the charge is within regulated distances, the company should go through the risk assessment with the pipeline company. It is generally safer to abandon the hole in a permanent manner (bentonite top to bottom) than to detonate it or remove it. Written agreement should be obtained from the Pipeline Company and landowner if applicable.

7.2 Surface Energy Sources

Safeguards should be implemented to ensure that the local population cannot get too close to the operating equipment. Third parties will often be fascinated by the equipment and may come too close and possibly injured. Safe operating distances from buildings and other structures should be observed at all times. Caution should be used when operating in areas with low power lines or other overhead obstructions.

Most surface energy-source vehicles use hydraulic systems. The operating pressure is typically 3,000 psi (2.1 kPa, 200 Bar); however, pressures as high as 6,000 psi (4.1 kPa, 400 Bar) are not unusual.(land airguns)

Personnel other than the operator should keep a safe distance when the system is pressured up. When the system is pressurized, leaks, blow-outs and ruptures can cause serious or fatal injuries.

Do not attempt to make adjustments or repairs until the system is pressured down. If adjustments must be made and the pressure is not zero, wear eye protection or a face mask. Do not forget the 40 to 100 psi (0.02 to 0.07 kPa, 3to 7 Bar) pre-charge in some systems, particularly in the reservoir.



7.2.1 Vibroseis

1. Vibrators should be equipped with proper safety equipment, such as fire extinguishers, first aid kits, radio, appropriate

warning signs, traffic warning triangles, back-up alarm, seat belts and emergency plans including spillage. The vibrator service truck and the vibrators should carry sufficient absorbent material to clean up after a spill.

2. Careful consideration should be given to the fitting of expanded metal screens to the rear cab windows to prevent damage from thrashing ruptured hydraulic hoses.
3. Inspections should be conducted prior to daily operations. This inspection should include -- but not be limited to -- tires, brakes, all fluid levels, steering, back up alarms, hoses and a walk around before moving the vehicle.
4. Use footsteps and hand rails while entering or exiting the vibrator. Never jump from the cab to the ground. Ensure the walking area on the back deck of the vibrator is covered with a non-slip surface.
5. A vibrator (buggy or truck) normally has a high center of gravity and good judgment should be exercised when in rough terrain.
6. Due to the size and configuration of these vehicles, special attention should be given to stopping, following, turning and overall speed. Follow other vehicles at a safe distance in case of an emergency stop.
7. Hearing protection should be provided and worn when working close to an operating vibrator.
8. Do not leave the unit unattended if it is pressured up.
9. Be careful when walking or standing near a working vibrator. Never walk or park between vibrators. The vibrator works rapidly and the operator's attention may not be directed outside the cab at all times. On slopes, the vibrator tends to slide or to vibrate slightly down slope, especially on mud, sand, ice, or snow. Always get the operator's attention and permission before approaching a vibrator.
10. Do not attempt repairs or maintenance while the hydraulic system is pressured up. Repair any hydraulic leaks immediately.
11. Do not place any part of your body under the mass.
12. Do not raise the vibrator to change tires or make repairs unless the axles are blocked or cribbed.
13. Use only dry nitrogen to charge vibrator accumulators. Be extremely careful that oxygen or other compressed gases are not mistakenly used. Each compressed gas bottle should be clearly and legibly marked (color coded) as to its contents.
14. Clean up all oil spills immediately with spill kits or similar materials.
15. When maneuvering vibrators in congested and confined work areas, due to poor visibility and blind spots, a spotter should be used. When backing a vibrator, be cautious of the location of the spotter to prevent an incident.



7.2.2 Land Air Gun

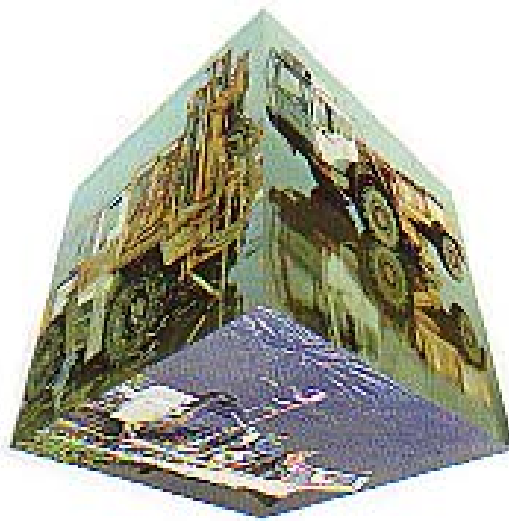
- 1) The land air gun operates under extremely high pressure and can be dangerous. Only qualified persons should operate the air gun, its handling gear or the air compressor. All other personnel should stay clear of the equipment any time it is running or pressured up. Always assume the system is pressured up.
- 2) Use extreme caution by monitoring the system and the area around the equipment when pressured up and operating.
- 3) Keep the firing switch OFF unless the air gun bell or enclosure is on the ground or in the water, ready to fire and the operator is at the controls.
- 4) Never leave the system unattended when it is pressured up.
- 5) Never handle, tighten, or loosen bolts or fittings, or hammer on any part of a high-pressure air system, when the pressure is applied.
- 6) Make sure that all pressure is released and that the shuttle is open before touching an air gun with your hands.
- 7) Inspect system regularly and replace any worn or faulty parts.
- 8) Be certain that all replacement parts meet the equipment manufacturer's specifications.

7.2.3 Weight Drop Units

- 1) Never attempt repairs or adjustments until the weight is on the ground and the electronic raise – drop controls are deactivated (LOTO)
- 2) Never place any part of your body between the weight and the ground unless the weight is carefully and properly blocked and bridged.

- 3) Never place and part of your body between the weight and the vehicle unless the weight is chained off or safely chocked or bridged.
- 4) Do not use the weight as a work platform or table.
- 5) Check the cables and the chains daily. Replace distorted or damaged chains immediately.
- 6) When cleaning the weight, use a long handled scraper and never place any part of your body past the safety chains.
- 7) Do not allow anyone to approach closer than 10m = 30 feet during weight drop operations. Hot oil under pressure, ricocheting mud, dirt, rock and other debris can cause serious injury.
- 8) Appropriate PPE includes eye protection (flying debris), hearing protection (noise) , etc. as per risk assessment

8. VEHICLES



8 VEHICLES

8.1 General

Party Chiefs, managers and supervisors should ensure that all new drivers are tested before they are permitted to drive a vehicle.

The following rules should be strictly observed:

- 1) Drivers should always have and carry a valid driver license for the type of vehicle they are operating and be sure that registration and permit plates are available for all official inspections. Ensure that all vehicle operators who transport hazardous materials have the appropriate operator's license and training according to local regulatory requirements.
- 2) All passengers should be properly seated or standing on a properly constructed working platform when the vehicle is in motion. Do not get on or off a vehicle while it is moving. Consideration should be given to providing fall protection / prevention for these work areas based upon risk assessment.
- 3) The use of riding platforms is for designated personnel only. No unauthorized personnel should ride on these platforms.
- 4) Do not smoke during fueling operations. Each fuel tank should be clearly marked NO SMOKING, and the type of fuel should be clearly identified near the fueling spout. Shut the engine off before refueling.
- 5) The vehicle operator should ensure that a daily visual inspection of all vehicles has been made. Before the vehicle is moved, brakes, steering, horn, lights and tires should be in proper operating condition and all lights, windows and reflectors should be clean. Left and right rear view mirrors and windshield wipers should be in good condition. Walk around your vehicle prior to driving.
- 6) The driver should check that no equipment or people are in the path or under the vehicle before starting or moving.
- 7) No one is permitted to perform maintenance on or under a vehicle with the keys in the ignition unless under the direct supervision of the mechanic. (Lock Out Tag Out procedure)
- 8) No one is permitted to rest, sleep or otherwise recline under a vehicle at any time
- 9) Do not leave or store equipment under a parked vehicle.
- 10) Portable heaters are not recommended in any type of vehicle.
- 11) Use skill and judgment in selecting the speed for all vehicles. Use of speed monitoring devices and speed limiting and/or radar gun or speed detector is recommended.
- 12) All drivers should respect the established speed limits set by the client or the crew procedures in their areas of operations.

- 13) Do not throw litter or cigarettes out of the vehicle, and where there is wildlife take special care while driving to avoid incidents.
- 14) All vehicles should be fitted with the following:
 - a) Fire extinguisher.
 - b) First aid kit.
 - c) Communications; radio or telephone and emergency plan where appropriate.
 - d) Seat belts on all seats for all occupants in front and back.
 - e) Serviceable spare wheel.
 - f) Tool kit including jack and wheel nut spanner (lug wrench).
 - g) In off-road situations or where the possibility of roll over exists, the occupants of light commercial vehicles should be protected by a steel roll bar or roll cage if steel body shell protection is not provided.
 - h) Survival kit if work location dictates. Configured to account for site hazards as determined by risk assessment.
 - i) Roof top identification is recommended for vehicles operating in remote or hazardous conditions, or involved in helicopter operations.
 - j) Reverse warning/ backup alarm device if appropriate.
 - k) Maps.
 - l) Portable Global Positioning System (GPS) receiver where appropriate.

8.2 Seat Belts



Many fatalities and serious injuries occur in vehicles because occupants are not restrained. SEAT BELTS SAVE LIVES! All personnel, both drivers and passengers, should wear seat belts.

Crew transport busses / vehicles should be fitted with 3 point or harness type seatbelts wherever possible.

The use of seat belts by all seated occupants of vehicles (e.g., cars, trucks, personnel carriers, off road utility vehicles, heavy goods vehicles etc.) is mandatory when in motion.

8.3 Distracted Driving

Distracted driving is any non-driving activity that takes the driver's attention from the primary task of operating the vehicle and thus increases the risk of crashing. There are three main types of distraction:

1. Visual—taking your eyes off the road

2. Manual—taking your hands off the wheel
3. Cognitive—taking your mind off your driving

8.3.1 Common Activities That Can Distract A Driver:

- Using a cell phone
- Eating while driving, drinking coffee
- Talking to passengers
- Reading maps
- Programming GPS
- Radios usage
- Changing the radio station, CD, or MP3 player
- Texting
- Catching unsecured moving objects in cab or dashboard

Note: Using a cell phone while driving delays a driver's reactions as much as having a blood alcohol concentration at the legal limit of .08 percent.

8.4 Journey Management

Journey management is essential to control and monitor the movement of personnel, vehicles, boats and aircraft.

Without journey management, personnel can be exposed to unnecessary hazards.

The following applies to both vehicles and boats:

- 1) Before a vehicle or boat can be used for work, the driver should use a checklist to ensure that the vehicle or boat is mechanically sound and that the necessary safety equipment is in place.
- 2) Before the journey begins, the supervisor should inform the driver of the destination.
- 3) The supervisor should then inform the destination as to the Time Of Departure (TOD) and the Estimated Time of Arrival (ETA), the number of personnel traveling, and the number and type of vehicles or boats.
- 4) When the vehicle or boat arrives at its destination, the driver should report to the radio operator that the vehicle or boat has arrived.
- 5) The radio operator should inform the point of departure of the arrival of the vehicle/boat/aircraft, confirming Time of Arrival and that all personnel are accounted for.
- 6) The crew management should approve all journeys and routes.
- 7) Each base or camp site should designate a person who is responsible for recording vehicle/boat/aircraft movements. A periodic check in procedure should be established.
- 8) On reaching the destination, the driver should report any hazards encountered to the radio operator, who should pass the information to the Party Chief.
- 9) A radio communications log book should be kept and significant journey management events recorded

- 10) If the vehicle or boat is overdue by one hour, the radio operator should inform the Party Chief immediately who will decide if the search procedures should begin.
- 11) For each journey, the following should be recorded:
 - a) Destination.
 - b) Name of driver.
 - c) Name or registration of vehicle or boat.
 - d) Time of departure.
 - e) Estimated time of arrival.
 - f) Actual time of arrival.
 - g) Number of personnel on board and if any special skills, like paramedic, mechanic.
- 12) Driver Fitness and Alertness Driver fatigue, rest, hours of service etc..
- 13) In vehicle monitoring and tracking systems have proven to be very effective in tracking transportation movements and are highly recommended.

Consideration should also be given to create a personal journey management plan for all travel, including business travel, personnel on crew rotations, etc., such as estimated time of departure, ETA, confirmation of arrival, and notification of travel interruptions/delays. Note this section also relates to security section above

8.5 Fueling Operations -- Vehicles



The following precautions should be taken when planning a fuel storage location and during fueling operations:

- 1) The area around the fuel storage should be kept free and clear of any dried grass and weeds for at least 8 m (25 ft).
- 2) Personnel carrying out fuelling operations should be trained and competent to perform the work, including awareness of associated hazards & emergency procedures.
- 3) Fuel storage should be at least 8m (25ft) away from any power source (electrical power supplies, switch boxes, transformers, etc.)
- 4) No smoking should be allowed within 15m (50ft) of fuel storage and while fueling is in progress. Warning signs should be displayed around the storage and fueling site.
- 5) In case different types of fuel are used, tanks and delivery hoses should be clearly identified.
- 6) Fuel storage areas should be surrounded by secondary containment systems or earth berms lined with seamless, impervious material. They should be of sufficient volume to fully contain the fuels stored plus a freeboard excess of 10-50% depending on local requirements.

- 7) Dry powder or foam fire extinguishers should be positioned within 15m (50ft) of each pump or dispenser.
- 8) Fuel pumps should be of the type manufactured for fuel operations. Electric pumps particularly should be of non sparking type.
- 9) All electrical systems should be grounded.
- 10) Fuelling equipment should be fit for purpose. Nozzles and fittings should be of non-sparking material, hose should be rated for fuel/oil delivery.
- 11) The engine of the vehicle to be fueled should be turned off while fueling. The vehicle should be parked with the hand brake on and gear engaged.
- 12) Where practical, two people should be present for fueling operations in case of an incident.
- 13) Drip trays should be used to prevent inadvertent ground contamination, spill cleanup material should be available
- 14) While fueling turn off all cell phones. All occupants should abandon the vehicle while it is being fuelled. Avoid entering and exiting of the vehicle.
- 15) Care should be taken by the fueling person to avoid splashes. Splashes on the skin may cause irritation. Splashes on clothes may cause later ignition when the fuel evaporates.

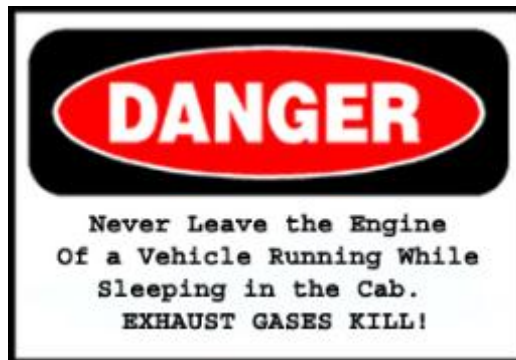
8.6 Vehicle Operator Safety

Defensive drivers make allowances for the other person's lack of skill and knowledge and recognize that they have no control over the weather, the conditions of the road, or the unpredictable actions of other drivers or pedestrians. Therefore, they think ahead and make concessions to avoid collision. They are careful to commit no driving errors themselves and are defensively alert to avoid the incident created by weather, roads, pedestrians, other drivers and in vehicle distractions.

- 1) Keep yourself physically fit and mentally alert.
- 2) Be familiar with local regulations. Guard against road mishaps by making routine checks of the distribution of your load; also check steering gear, tires, brakes, lights, windshield wipers and horn. If flares, fuses and flags are required on your vehicle, be sure you have the sufficient number at all times.
- 3) If your vehicle carries a high load, check all clearances of underpasses. See that your load is properly distributed. Give attention also to tailgate, tarpaulins, chains, ropes, etc. Red flags in daytime and red lights at night should be attached to any object extending beyond the tailgate.
- 4) Drive at a speed consistent with the condition of the road surface, the traffic density, the degree of visibility and within the posted speed limit. Maintain a safe distance when following another vehicle. The condition of the road, speed, visibility, the weight of the load and the braking ability of your vehicle determine this distance. Never operate a vehicle at speeds that will not permit

- you to stop within a safe distance. Use the two-second rule for cars and the four-second rule for trucks to maintain a safe following distance.
- 5) If your vehicle is equipped with anti-lock brakes, pumping your brakes may inhibit the functionality of your anti-lock system
 - 6) If your vehicle is equipped with auto steering lock, **NEVER TURN OFF THE IGNITION OF YOUR VEHICLE WHEN IT IS STILL IN MOTION.** This could cause the steering to lock and you would lose control of your vehicle.
 - 7) Any time you are driving in conditions of limited visibility, such as blowing snow, sand, dust, rain, or fog, use extreme caution. Do not forget to turn on your headlights, use the low beam and stay alert! Maintain a safe distance for conditions. Be aware of those vehicles following too close behind you. Avoid overtaking if possible.
 - 8) Approach children and pass through pedestrian traffic cautiously. Be particularly careful to give elderly persons and children the right-of-way.
 - 9) Best practice is never pass a (school) bus in either direction while the bus is stopped and loading or unloading passengers, however this may not be the regulation or practice in all countries.
 - 10) Maintain the proper position in the line of traffic when going straight ahead or making a right or left turn. Signal your intentions at least 60 m (200 ft.) in advance of what you intend to do in order to give following traffic an opportunity to adjust accordingly. Check mirrors when making any turn for persons overtaking.
 - 11) Give clear signals before making turns, slowing down, or stopping. Do not use your horn unnecessarily. The horn is emergency equipment to be used only as a warning device. In many foreign countries, the horn is integrated into normal driving practices. Drivers should be aware of local driving customs.
 - 12) Do not depend entirely upon your rear view and side mirrors when changing lanes and making turns. Use them as an aid, always be aware of your blind spots and look backward and forward on both sides.
 - 13) Enter and cross intersections cautiously and do not cross until you can do so safely.
 - 14) Slow down before entering a curve and accelerate gradually as you round it. Do not attempt to pass another vehicle on a curve.
 - 15) When parallel parking, facing uphill, back the front wheel into the curb. Set the parking brake securely.
 - 16) If you have to stop a vehicle on a highway at night, use emergency warning signals immediately. Place illuminated markers at the traffic side of your vehicle and approximately 30 m (100 ft.) behind and in front of your vehicle. Similarly, use clearly visible markers for this purpose in the daytime (cones, reflectors, flags, flares)

- 17) Do not pick up hitchhikers.
- 18) Do not drive while under the influence of alcohol, drugs, or narcotics.
- 19) All employees boarding or exiting from cars or trucks should do so at the curb side.
- 20) Jumping on or off moving vehicles is prohibited.
- 21) Avoid backing when possible. When parking, look for a space where you can drive straight out. When you must back up, have someone direct you or walk around your vehicle to make sure nothing is in your way. The fitting of reversing alarms is recommended on all vehicles.
- 22) Winter driving requires special care since snow, ice, sleet, rain, mist or fog decreases traction and visibility. The following are precautions to take:
 - a) On slippery ice or snow, start in one of the higher gears and engage the clutch slowly.
 - b) Chains or winter tread tires should be used when snow or ice causes hazardous driving conditions.
 - c) Approach all curves and braking situations cautiously. Do not solely rely on chains, winter tires or other skid control devices.
 - d) Keep defrosting equipment in good working order. All windows should be free of ice and frost.
 - e) To avoid the dangers of carbon monoxide, see that the cab is well ventilated at all times.



- f) Winter driving conditions call for reduced speed.
- 23) When driving at night, you should assume certain responsibilities to attain maximum safety:
 - a) Check all lights regularly, ensuring they are properly adjusted, clean lenses and ensure all lights operate.
 - b) Drive your vehicle at a speed consistent with its braking ability and the degree of visibility.

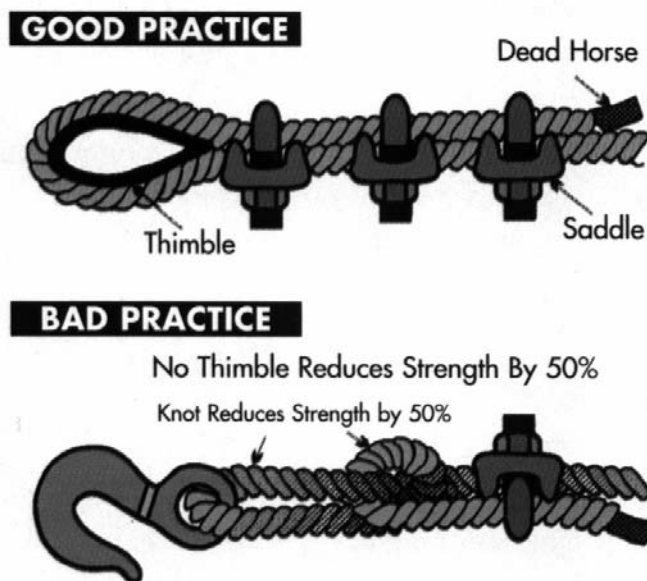
- c) Pass oncoming vehicles with your low-beam headlights on. This is the courteous and the safe thing to do. Use low beams when following other vehicles or driving in foggy conditions.
 - d) Reduce speed when oncoming bright lights hamper vision.
 - e) At dusk, turn on low-beam headlights. More vehicle incidents occur during the time from sunset to total darkness than any other time of the day. Most of these incidents are caused by drivers who fail to turn on their lights as daylight fades.
 - f) Switch to low-beams when driving through a city or town.
- 24) After driving in water, brakes may become wet and are not effective. Apply the foot brake lightly and repeatedly for a short period to dry the brakes.
- 25) It is easy to make safe driving a habit. A safe and careful driver is also a courteous driver. Your attitude on the road and the way you drive is a reflection of you and your company.
- a) To avoid intersection incidents, never assume you have the right-of-way.
 - b) Take your turn in traffic. Do not crowd other vehicles. Do not demand the right of way.
 - c) Do not weave from one lane to another.
 - d) When other drivers signal that they wish to pass, permit them to do so.
 - e) Pass vehicles only when there is ample room to get back safely into your own lane. Be very aware of any oncoming traffic.
 - f) Allow pedestrians to cross ahead of your vehicle.
 - g) When parking, do not block pedestrian cross walks, private drives, emergency exits, or other entrances. Do not obstruct fire hydrants.
 - h) Never apply your brakes suddenly when you have a flat tire or blowout. Take your foot off the accelerator and apply the brakes cautiously.
 - i) If you run off the road, slow your speed before attempting to return to the road.
 - j) Watch carefully for people riding bicycles, especially children.
 - k) Do not coast with gears in neutral or drive with the clutch pedal pushed down except when shifting gears. When going down steep grades use a lower gear.
 - l) Keep your seat belt fastened at all times and insist that your passengers use them.
 - m) Obey every traffic sign and signal.

8.7 Passenger Protection in Vehicles

Geophysical operations involve a considerable amount of passenger transportation. The standard of protection provided for passengers varies with different vehicle manufacturers and in different countries

and may not be adequate for the intended use of the vehicle. It is recommended, therefore, that the following measures be taken for the protection of passengers in vehicles:

- 1) All seating should be securely fixed, forward facing, head rests, be in good condition and fit for purpose. Passengers should be seated and wearing a seat belt while traveling.
- 2) Seat belts should be of high quality construction to a recognized international standard, correctly installed and maintained in excellent condition at all times. A schedule of inspection by a competent person should be maintained.
- 3) All passenger vehicles have specific handling characteristics particular to that vehicle. Care should be taken in the load distribution of passengers and cargo, so as not to make the vehicle handling unstable.
- 4) There should be means for the driver to observe passengers carried in the rear of the vehicle. If this is not possible, there should be a means for passengers to signal the driver from the rear compartment.
- 5) Passengers and freight should be carried in separate compartments. Freight should be secured.
- 6) On trucks, buggies and semi-trailers converted to passenger-carrying service, fixed sides should be fitted to the passenger space at least to the shoulder height of seated passengers and roll



over protection provided.

- 7) Passenger compartments should have a secondary means of escape

8.8 Winches and Cables

- 1) Winches should only be operated by trained personnel.
- 2) The winch cable should be unspooled and inspected regularly. If more than 5% of the wires can be seen to be broken in a 30 cm (1 ft.) length or there are kinks, the cable should be replaced.
- 3) The winch cable should be kept clean and oiled with a light preservative. When re-spooling, avoid kinking the cable.
- 4) Always wear leather gloves when handling winch cables. Always guide cable hand over hand when re-spooling.
- 5) Apply moderate pressure to the end of winch cable when re-spooling to keep it running smoothly.
- 6) Do not stand near, step over, or go underneath a cable. It may suddenly go under tension or it may break with a whipping action and fly through the air. Care should be taken to keep non-essential persons away from the work area, at a safe distance of at least twice the length of cable under tension. Keep bystanders away.
- 7) Stand clear of objects being lifted or pulled. If the cable breaks, the objects may fall or roll back.
- 8) Do not stretch a cable across a road or street. Do not hook cables on telephone or telegraph poles. Do not use man-made objects as an anchor unless prior approval has been obtained from the owner.

8.9 Convoying

A convoy could be as simple as a single vehicle leading another to a specific destination, or as complex as dozens of vehicles and towed equipment making a major crew move. All convoys, no matter what size should consider the following.

- 1) A pre-convoy meeting with convoy leaders and drivers should be held to discuss the route, speed, resting places, road and traffic conditions. Maps showing contact numbers and locations of emergency service, particularly hospitals, are helpful. See journey management procedures.
- 2) Minimum vehicle spacing distance should be considered on a case by case basis and take in to account the configuration of the convoy, any local regulations, conditions or practices that may apply. A minimum distance of 100m (300 ft) between vehicles to permit other traffic to move with ease around slow-moving vehicles may be a good rule of thumb. After the convoy has started moving, no vehicle in the convoy should change position.
- 3) All vehicles in the convoy, including personal automobiles, should travel with their headlights on, if local regulations permit.

- 4) After moving through large towns, the convoy should resume its original position with spaces between, to allow other vehicles to pass.
- 5) A mechanical support or service vehicle should travel near the rear of the convoy.
- 6) All drivers in the convoy should maintain radio communications.
- 7) Despite all the convoy planning and controls, individual drivers are still responsible for the safe operation of their vehicle and should remain vigilant with regards hazard awareness and good defensive driving practice.
- 8) A pick-up truck with flags, amber lights and the slow-moving vehicle sign should tail a slow-moving convoy.
- 9) Large numbers of vehicles should be split up into smaller sub-groups for each section of the journey.

8.10 All Terrain Vehicles (ATV) Safety

The use of ATVs is not recommended. All Terrain Vehicles (ATVs) can be dangerous to operate. Severe injury or death can occur from accidents on All Terrain Vehicles (ATVs). An All Terrain Vehicle (ATV) is defined as being a single seat vehicle with three or more wheels, which has a seat that has to be straddled and has handlebars for steering. Three wheeled All Terrain Vehicles (ATVs) are extremely dangerous and should not be used.

The handling of an All Terrain Vehicle (ATV) is said to be "rider active." The position of the All Terrain Vehicle (ATV) operator and/or the cargo loaded on the All Terrain Vehicle (ATV) can drastically alter its handling characteristics and maneuverability.

All Terrain Vehicles (ATVs) are designed for off-road use. Handling characteristics change drastically on pavement. Stay off paved roads. In many places, it is unlawful to operate an ATV on or near public roads. When operating an All Terrain Vehicle (ATV), drive defensively. Other traffic cannot see you! Yield to other traffic.

All Terrain Vehicles (ATVs) with one seat are designed to carry **only ONE** person; **the operator**.

If ATV use is required the following should be followed:

- 1) All operators should be properly trained and certified in All Terrain Vehicle (ATV) use. Some jurisdictions may require an operator's certificate.
- 2) Personal Protective Equipment (PPE):
 - a) Approved head protection (¾ shell or full shell motorcycle helmets). ½ shell helmets are not designed for off-road use. Hard hats are not motorcycle helmets and are unacceptable.
 - b) Face shield or goggles.
 - c) Jacket or long sleeved shirt.

- d) Gloves.
 - e) Long pants.
 - f) Boots.
 - g) High visibility clothing.
- 3) Always perform a pre-ride inspection to minimize the chance of injury or being stranded because of mechanical problems. Bear in mind you can ride further in an hour than you can walk in a day.
- a) Tires and wheels.
 - b) Controls and cables
 - c) Lights and electrics.
 - d) Oil and fuel.
 - e) Chain and drive shaft chassis.
- 4) Ride within your skills.
- 5) Scan the environment for hidden obstacles and hazards such as large rocks, stumps, holes, washouts and fences.
- 6) Set the parking brake when getting off the All Terrain Vehicle (ATV). You will not always be on level ground.
- 7) Do not use excessive speed.
- 8) Follow local laws and regulations.
- 9) Plan ahead. Carry a radio, small tool kit, small first aid kit and snacks.
- 10) When carrying cargo, evenly distribute the weight and make sure it is securely fastened down.
- 11) Ride environmentally friendly.
- 12) Adding a whip flag to the ATV makes it more visible.

8.10.1 All Terrain Vehicle (ATV) Night Operations

Night operations using All Terrain Vehicles (ATVs) greatly increase the risk of accidents due to restricted visibility and should be considered carefully.

8.10.2 Other Utility Vehicles



A Utility Vehicle is defined as being a small sized, multiple use utility vehicle with four wheels designed for off-road use only. It has a bench seat and steering wheel similar to that of a car or truck, but not considered a motor vehicle. It can carry passengers. These are not manufactured for use on public highways

or streets. In many places, it may be unlawful to operate a utility vehicle on or near public roads.

The Utility Vehicle has specific handling characteristics. The position of the Utility vehicle operator, passengers and/or the loaded cargo can drastically alter its handling characteristics and maneuverability.

When operating these units, drive defensively. Remember when crossing or operating near highways, other traffic may not see you! Yield to other traffic.

- 1) All operators should be properly trained and certified in utility vehicle use. Some jurisdictions may require an operator's certificate.
- 2) The units should be equipped with roll over protection
- 3) Personal Protective Equipment (PPE):
 - a) Approved head protection (motorcycle helmets) is recommended. Hard hats are not motorcycle helmets and are unacceptable.
 - b) Face shield or goggles.
 - c) High visibility clothing
- 4) Always perform a pre-ride inspection to minimize the chance of injury or being stranded because of mechanical problems. Bear in mind you can ride further in an hour than you can walk in a day.
 - a) Tires and wheels.
 - b) Controls and cables
 - c) Lights and electrics.
 - d) Oil and fuel.
 - e) Chain and drive shaft chassis.
- 5) Seat belts should be worn at all times by both operators and passengers
- 6) Drive within your skills.
- 7) Scan the environment for hidden obstacles and hazards such as large rocks, stumps, holes, washouts and fences. Avoid driving through rivers or streams where the water is above the axles, particularly if the water is fast moving. Double check water depth forging ahead.
- 8) Set the parking brake when getting off the utility vehicle. You will not always be on level ground.
- 9) Do not use excessive speed.
- 10) Follow local laws and regulations.
- 11) Plan ahead. Carry a radio, small tool kit, small first aid kit and snacks.
- 12) When carrying cargo, evenly distribute the weight and make sure it is securely fastened down.
- 13) Drive environmentally friendly.

- 14) Adding a whip flag to the unit makes it more visible. Drive with lights on

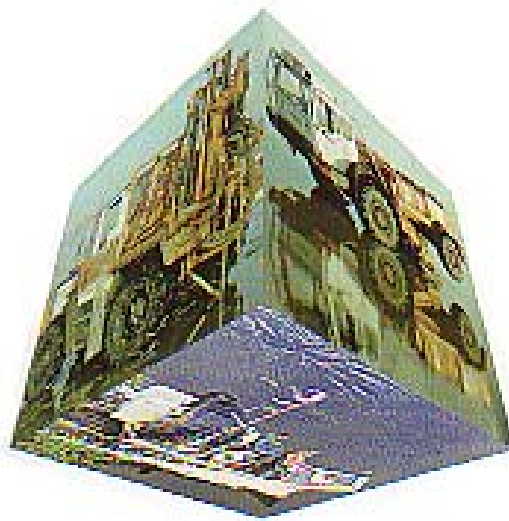
8.11 Snowmobiles

- 1) All operators should be properly trained and certified in snowmobile use. Some jurisdictions may require an operator's certificate.
- 2) Service the snowmobile before beginning winter operations. Keep a regular maintenance schedule throughout the season.
- 3) Check equipment before every trip and inspect the mechanical operation of the snowmobile.
- 4) Personal Protective Equipment (PPE) should be worn, e.g., helmet, gloves, cold weather gear/clothing, eye protection, high visibility clothing or tarp. Keep in mind wind chill.
- 5) A hand-held radio should be taken on all trips. It may be useful to carry a Global Positioning System (GPS) receiver.
- 6) Keep snowmobile clean of dirt, ice and slush.
- 7) Do not stand in front of or behind the snowmobile when the engine is running. The track may eject debris rearward when pulling away.
- 8) Begin your trip with a full tank of fuel.
- 9) Carry a basic tool kit, spare drive belt, first aid kit, waterproof matches, candles and high energy food.

Carry a flashlight (torch). Keep to a safe speed. Beware of rocks and tree stumps hidden by recent snowfalls.

- 10) Avoid waterways. Traveling on frozen lakes and rivers can be fatal. Check with local authorities or residents about ice conditions of inlets, outlets and waterways. Plan all journeys carefully.
- 11) Beware of fences, fence posts, guy wires.
- 12) Check weather forecast and file a travel plan prior to departure. See journey management procedures.
- 13) Never operate a snowmobile while you are under the influence of drugs or alcohol.
- 14) Always drive within the safety of your headlights to illuminate hazards.

9. WATER OPERATIONS



9 WATER OPERATIONS

9.1 Small Boat Operations



The mission of the small boat should be compatible with the boat's size, propulsion system, impending weather and time of day.

Small boat operations should consider such hazards as predators (sharks, snakes, alligators), floating debris, low hanging limbs, shallow water, currents, tides, tidal bores, flash floods and anything hazardous to the boat and its passengers.

When boarding a small boat from a dock or from another boat, never jump. Step slowly into the center of the vessel.

When boarding a small boat or skiff from the water, enter from the stern or bow (front or back), not the side, to prevent tipping the boat. When someone is in the water near the boat, the engine should be off.

Boats should be at least equipped with the following:

- 1) Approved flotation devices for each person and a life ring.
- 2) Fire extinguisher.
- 3) Extra line or rope.
- 4) Paddles.
- 5) First aid kit.
- 6) Basic tool kit including extra prop, and shear pins and flashlight.
- 7) Ample fuel.
- 8) Kill-cord (dead-man's handle or switch).
- 9) A waterproof radio.

9.1.1 Precautions

1. Personal Flotation Devices (PFDs) should be worn when operating from small boats.
2. Do not operate equipment and ~~vehicles~~ watercraft at night unless sufficient lights enable safe operations.
3. Do not overload boats. Distribute weight properly. Cargo and passenger capacity should be displayed on the boat.
4. Boat to boat transfers at sea are a risky activity and this should be considered carefully. Every effort should be made to reduce exposure. Adequate operations planning, monitoring sea state, safer platforms, use of swing ropes are all suggestions that can help mitigate risk.

5. Stay with the boat in case of breakdown or disablement over water.
6. Never refuel while the engine is running and do not smoke or use gasoline or kerosene lanterns or lamps while refueling.
7. When using gasoline inboards, be certain the bilge is ventilated before starting the engine.
8. Do not operate boats during electrical storms or extreme weather.
9. Check the fuel supply often.
10. Any oil or fuel spills should be cleaned up thoroughly and in an environmentally friendly manner. Oil swabs and soap should be kept handy at all times.
11. Non-skid surfaces should be used wherever possible.
12. Obstruction that might cause a trip or fall should be minimized and painted with high light paint where possible.
13. When working in hot climates, a sun cover should be put over the boat to avoid heatstroke, sunburn and Ultra Violet (UV) exposure.
14. When using an inflatable small boat, the crew and passengers should not carry sharp objects. Tools should be properly stored. It is also recommended that inflatable small boats are covered when not in use to reduce exposure to adverse conditions, deterioration, or damage.

9.1.2 Maintenance

- 1) Small boats should be included in the preventive maintenance schedule.
- 2) Regular inspection should include, but not be limited to, inspection of overall structural integrity, fuel lines, steering and throttle mechanisms, coolant, oil levels, life jackets and all items as specified in the checklist defined on the crew.

9.1.3 Training and Competence

- 1) All boat handlers should be trained and competent for the size and type of craft they are operating.
- 2) All personnel boarding a small boat should have been given the necessary Health, Safety and Environment (HSE) and job- specific briefing & training in compliance with the Contractor's HSE policy and procedures.
- 3) The training should comply with the OGP /IAGC Safety Training Guidelines for Geophysical Personnel.
- 4) All members of the small boat crew should have been trained in basic first aid/CPR and overboard rescue and retrieval.

9.2 Airboats

- 1) Never stand next to or behind the propeller of an airboat when the engine is running.
- 2) Never approach the airboat from the rear when the engine is running. The rear of the airboat is a blind spot for the operator. Make the airboat operator aware of your presence at all times.

- 3) Always be aware of the airboat prop-wash. It is very powerful and can knock people down, capsize other boats, break windows and blow loose objects with tremendous force.
- 4) Secure all objects, preferably with a net or tarpaulin and keep them away from the propeller. All airboats should have a full safety shroud around the propeller. Keep the boat free of debris.
- 5) The airboat operator is responsible for safety on board the airboat.
- 6) Wear a buckled life vest at all times.
- 7) Always wear ear and eye protection when the airboat is in motion or the engine is running.
- 8) Do not overload the airboat. Post the maximum load and/or passenger limit in the boat.
- 9) Balance the load.
- 10) Do not move or stand while the airboat is in motion.
- 11) Keep your hands and feet inside the airboat at all times. Wait until the airboat is completely stopped before getting out.
- 12) Airboats should operate at a reasonable speed, no more than 40-48 km/h (25-30 mph).
- 13) Airboats have a very low freeboard, extreme care should be taken when operating them in deep water.
- 14) Some airboats run with open exhaust. Watch for fires. Mufflers are recommended.
- 15) Smoking is prohibited when carrying flammable liquids, explosive materials or when refueling. Signs should be appropriately posted.
- 16) Equip the airboat with at least the following safety equipment:
 - a) Horn or whistle.
 - b) Fire extinguisher.
 - c) Life jackets for all personnel.
 - d) Flotation device that can be thrown to overboard personnel.
 - e) First aid kit and tool kit.
 - f) Oar

9.3 Telemetry/Transition Zone (TZ)

Shallow water and marine operations are subject to quickly changing and potentially volatile weather and sea conditions. These conditions create variables that affect not only the number and types of crew personnel but also types and amount of equipment utilized in deployment and retrieval operations.

- 1) Actual methods and procedures for deployment and retrieval of units (and related peripheral equipment) should be determined in accordance with **documented** company procedures with absolute adherence to safe and efficient personnel operations.

- 2) Prior to deployment or recovery of any equipment, all personnel involved, should understand the operating procedure and type of equipment being deployed.
- 3) Specialized equipment is available to provide mechanized assistance in the actual deployment and retrieval functions.
- 4) Check the operation and condition of all components of the equipment used for deployment and retrieval of telemetry units prior to beginning work.
- 5) A check on the expected weather conditions, water depth, obstructions and vessel traffic should be made before commencing any geophysical operation.
- 6) All related operations should be monitored by a “hands free” intercom system allowing supervisory personnel and applicable crew to communicate (and receive instant feedback) on an “as needed” basis with deployment or retrieval personnel.
- 7) All personnel should be thoroughly trained in their duties and the duties of other personnel functioning in the immediate vicinity.
- 8) Safety apparel and equipment (such as non-slip sole boots with steel toe, Personal Flotation Device (PFD), gloves, eye protection, hard hat, etc.) should be used to prevent personal injury.
- 9) All personnel not involved in the operation should clear the working deck.
- 10) Personnel should not stand on, jump over or position themselves in the path of the deploying cables as they feed off.
- 11) Personnel should keep clear of coiled rope. Personnel should not stand in a bight of rope.
- 12) Working decks should be kept clear of debris and washed down after deployment.
- 13) When work is complete, all tools and equipment should be stowed and secured.

9.4 Energy Source Boats

Source boats and barges usually require a large amount of equipment in a limited space. Energy systems and machinery are necessarily close to the personnel operating them. Often the energy source has to be lifted and lowered involving mechanisms, lines and levers. Energy source, power supplies, lifting devices and lifting equipment should be certified or fit for purpose, and pneumatic and hydraulic systems adequately installed and shielded.

There are numerous types and varieties of gun boats...Medium Gun Vessels, Gun barges, inflatable small source boats, pontoons, deployment from back deck towed gun arrays, deployment over the side, very shallow water less than 1 meter, etc. each with potential differing characteristics and requirements. Risk assessment should be carried out for each particular vessel type.

In addition to all the normal considerations for energy source management the following situations can exacerbate concerns:

- 1) Boat crews and boat handlers should be skilled and competent for the size vessel they are handling
- 2) Arrangements should be in place to obtain forecasts of weather and local environmental conditions on a continual basis
- 3) Noise levels can be due to machinery and energy source discharge, sometimes 'on deck'. Noise assessments should be carried out, and appropriate hearing protection provided for the identified hazard.
- 4) The small size of the craft may provide limited access and egress and also many slip, trip and fall hazards. Often it is necessary to work in awkward positions and in places where there is the risk of falling into the water. Deck openings should be protected to prevent falling. Decks should be kept as clean and oil-free as possible.
- 5) Personal Flotation devices & Proper footwear, such as non-slip oil resist steel-toed boots should be used when on deck. Care should be taken with regarding too loose clothing, straps, lanyards, etc. To prevent entanglement with operating machinery.
- 6) An emergency stop of should be provided on deck in an easily accessible position to stop the energy source and sound an alarm in case of incident or man overboard.
- 7) Communications problems between personnel on the air gun boat and barge, and between it and the other vessels of the operation. Formal communications facilities and control room/wheelhouse with soundproofing should allow for adequate communication conversation.
- 8) Limited maneuverability. Work should be well planned, and boat handlers able and competent to handle the particular craft
- 9) Limited stability. Full testing of craft and training of boat handlers in all normal operating requirements and failure scenarios.
- 10) Escape facilities and arrangements should be adequate for boat conditions and hazards present. EPIRBS, Rafts, Personal floatation devices, fire fighting gear, etc.
- 11) Manning levels, accommodation and shift changing balanced against weather Manual of Permitted Operations and Production pressures.
- 12) Personnel transfer arrangements. Formal boarding points and procedures.
- 13) Needs to refuel and transfer equipment at sea, especially due to the limited maneuverability of the vessel should be considered.

For additional information refer to the IAGC Marine Manual.

9.4.1 Energy Source & compressors, High Pressure Hazards

Air guns are devices that rapidly release compressed air into the water creating the effect of an explosion. To provide sufficient energy for geophysical surveys, compressors capable of generating extremely high pressures are required.

Seismic sources should not be operated in the vicinity of diving operations. Consult with the diving operator to determine a suitable schedule to ensure divers are not exposed to excessive sound pressure.

- 1) Only qualified persons should operate the air guns, the handling equipment and the air compressors.
- 2) All non-essential personnel should stay clear of equipment, including lines, rigging and booms while deploying, retrieving and working on air gun systems.

9.4.2 High Pressure hazards

The typical operating air pressures used in most air gun systems are 70 times greater than those used in a car tire. Any release of air at these pressures is extremely dangerous and can tear the flesh and force dust, air or even oil particles through the skin and into the blood stream – a situation called an embolism, which can be fatal.

Non-essential personnel should be clear of the area.

To minimize risks associated with high air pressure, observe the following:

- 1) Never put your hands in front of the jet of air or any pressurized discharge port.
- 2) All personnel in areas where there is a risk of the sudden release of air should wear ear and eye protection while the system is operating.
- 3) An eye wash station should be located in the gun area.
- 4) The storage tanks, pipes, lines and fittings used to carry and control this high pressure are specialized equipment and should receive special attention.

Never handle, tighten or loosen bolts or fittings or hammer any part of a high pressure system while pressure is applied.

- 5) Pressure-relieving valves and other safety devices should never be removed or modified, except for repair or adjustment by qualified personnel.
- 6) High pressure hoses should be tied off by a restraining device (Chinese fingers?) to hold the hose in place in case of hose failure.

- 7) Any block valves installed upstream or downstream of a relief valve should be locked in the open position.
- 8) When opening valves, always close the valve one-half turn after reaching the maximum open position.
- 9) Use of substandard replacement parts may be dangerous.
- 10) Use a protective screen or cage around the high pressure manifold in the gun control cabin, and where hoses or high pressure piping pose a risk to personnel, such as deck crossings and along walkways.

9.4.3 Explosion Hazards

Another danger of compressed air is the possibility of explosion. When high pressure air reacts with combustible fluids in the piping or other system components, explosions can occur. Explosions can also occur when high temperatures are created by sudden compression in the dead end (compression ignition) or when a gauge valve is opened to a vented gauge containing oil. Even a thin film of lubricating or hydraulic oil in the system piping may explode.

Once ignition occurs, propagation of shock wave may cause the pipes to be ruptured at many locations.

To minimize risks:

- 1) Open all valves slowly.
- 2) Keep all compressed air and air piping free of oil and other combustible contaminants.
- 3) Never assemble any pneumatic equipment using hydrocarbon oils or grease. Use only vegetable or synthetic oils (as used in compressors) or silicon grease.
- 4) Ensure the compressed air after-cooler is operating to specifications to prevent oil ignition due to high temperature.
- 5) Prevent ignition from other causes, such as electrostatic discharge, compression of oil foam in a pump, external shock and external fire.
- 6) On deck, repairs should be performed with care. Keep open flames and other heat sources away from the air lines and electrical cable.
- 7) During inclement weather, repairs should be performed under temporary cover.
- 8) Electrical soldering irons and lights should be grounded to the ships deck.

- 9) Use the proper hand tools to prevent slippage and injury to repairmen and the burring of hardware, which can cause further injury. (Any burrs on hardware should be filed down or the hardware replaced.)
- 10) Pipes and hoses should be secured at frequent intervals along their length so that, in the case of fracture, the ends do not whip.
- 11) Never run high pressure air lines electrical cable trays or alongside other critical cables and pipe work.

9.4.4 Compressed Air Source Handling

The air gun is the system component that requires substantial handling and maintenance and consequently, presents risks to personnel.

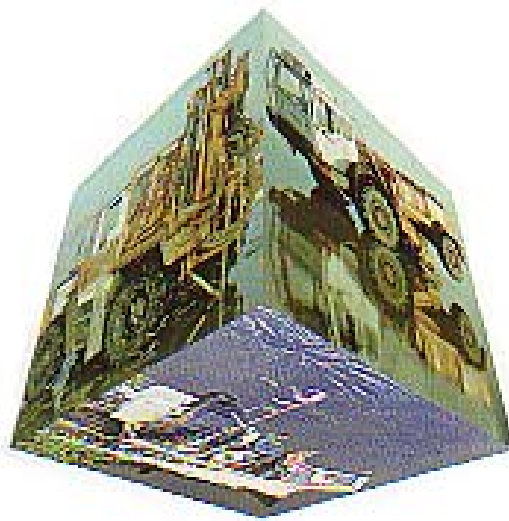
The main switches for disabling/enabling, triggering and pressure control should be operated from the deck by the crew working on the guns, not from a remote location.

The following should be observed:

- 1) If a person is exposed to the risk of falling overboard during the deployment or retrieval of guns, it is recommended that an attached safety harness be worn. A Personal Flotation Device (PFD) SHOULD be worn.
- 2) When retrieving, deploying or working on air guns, personnel should wear head protection, safety shoes, eye and ear protection.
- 3) Air gun operation involves high-pressure air hoses, electrical lines and towing cables. Care should be taken to prevent personnel from becoming entangled in or tripping over lines. Handle the high pressure hose and electrical cables carefully to prevent abrasion or undue strain on the covering.
- 4) Always bleed off the pressure in the guns before bringing them on board.
- 5) A lockout, tagout procedure should be used to prevent accidental re-pressurization of the system.
- 6) Ensure that all pressure is released before touching a gun.
- 7) Avoid test firing air guns on deck when possible. If such tests must be performed, do not test fire the air gun on deck or in open air until the area has been cleared a safe distance and safety measures implemented.
 - a) In test firing, air pressure should always be below 500 psi and all persons should be at least 8 m (25 ft.) from the gun or by placing a protective barrier between the gun and the person.

- b) Never handle the gun during testing and always wear protective equipment.
- 8) Every high pressure air injection injury, no matter how small, should be treated as a serious injury. In the event of an accidental exposure to high pressure air, if there is any swelling, pain or unusual discoloration of the area, it should be assumed that the person has been injected and the following guidelines should be followed.
- a) Make every effort to have person transported to the nearest hospital by the fastest method of transportation available but not at high altitude.
 - b) The treatment by a medical doctor should be started within six hours after the injury is sustained.
 - c) You can treat the injured by elevating the affected part of the body above the level of the heart to minimize swelling and by placing a constriction bandage between the wound and the heart. An injection of air or foreign objects may have occurred, even though there is no visible damage to the skin. The absence of pain is not to be accepted as a lack of injury nor as a positive sign.

10. CAMPS



10 CAMPS

10.1 Camp Operations

10.1.1 Electrical Wiring

Good workmanship and proper materials should be used when putting in place an electrical distribution system in a seismic camp. All metal work should be grounded in order to discharge electrical energy without danger. All wiring should be installed according to the national electric code of that country, or company standard whichever is higher, provided the materials to uphold the company standard are available in country or can be imported.

- 1) Equipment should be constructed, installed and protected and be capable of being maintained, inspected and tested so as to prevent danger.
- 2) Equipment and electrical conductors should be suitable for the maximum power required by the current-using equipment.
- 3) Electrical joints and connections should be of proper construction with respect to conductor size, insulation and mechanical strength and protection.
- 4) Every circuit should be protected against overcurrent by automatic tripping devices.
- 5) Electrical equipment cabinets and metal housing could cause danger if the conduit or insulation should become defective or if a fault should occur in any equipment. Electrical equipment metal housing should be grounded.
- 6) No fuse or circuit breaker, other than a linked circuit breaker, should be inserted in a grounded neutral conductor. Any linked circuit breaker inserted in a grounded neutral conductor should be arranged to also break all related energized conductors.

All conductors should be insulated and safeguarded to prevent danger.

- 7) A single-pole switch should be inserted in the energized conductor only. Any switch connected in a grounded neutral conductor should be a linked switch and should be arranged to also break all the related energized conductors.
- 8) Effective means, suitably placed for immediate operation, should be provided so that all voltage may be cut off from every installation and circuit to remove and prevent danger.
- 9) For every electric motor, an efficient means of disconnect should be readily accessible, easily operated and placed to prevent danger.
- 10) Every piece of equipment that requires operation or attention by a person in normal use should be installed so that adequate and safe means of access and working space are provided.
- 11) All equipment likely to be exposed to weather, corrosive atmospheres, or other adverse conditions should be constructed or protected to prevent danger arising from such exposure.

- 12) All equipment in surroundings susceptible to risk of fire or explosion should be constructed or protected to prevent danger.
- 13) No additions or alterations, temporary or permanent, should be made to an existing installation, except by an authorized and competent person.
- 14) All unsafe appliances, wires and electrical apparatus should be reported immediately to the electrician or supervisor and be removed from service.
- 15) Treat all wires as live wires. Do not touch hanging or broken wires. Place a warning sign and notify a supervisor or electrician immediately.
- 16) All electrical hand tools should be properly grounded. All kitchen equipment, including fry pans, griddles and toasters, should be grounded and kept in good working condition. Do not disconnect or break the ground wire on any equipment or fixtures.
- 17) Check drop lights for breaks in the insulation and before use. Ensure that the plug and socket are in good condition. Use only the bulb wattage rated for the light. All drop lights should be shrouded.
- 18) Use hand-held portable battery lights when working in damp areas or in metallic tanks. Ground Fault Interrupt (GFI) protection should be used in wet areas.
- 19) De-energize and tag or lock out all circuits before working on or close to electricity lines. Under certain conditions even low voltage can kill.
- 20) Avoid touching transmitting antennas. Severe burns and tissue damage can occur when the radio is in the transmit mode.
- 21) Test ELCBs (Earth Leakage Circuit Breakers)

10.1.2 Kitchen Hygiene

- 1) Kitchen and dining facilities, whether in tents or mobile units, have the same requirements for cleanliness and sanitation. Floors, walls and ceilings should have smooth and easily cleaned surfaces and be clean any time food is being prepared or eaten. Counter-tops should be covered by a smooth, hygienic, easily cleaned surface (e.g. stainless steel sheet).
- 2) Cleaning can reduce spoilage of perishable items and retard the spread of communicable diseases. A good disinfecting solution is 1 tablespoon of household bleach in a gallon (4 litres) of water.
- 3) Use colored chopping boards to prevent cross-contamination. Chopping boards should be of a material that is easily cleaned and disinfected.
- 4) Separate sinks should be used for hand washing and food preparation.
- 5) Wash dishes and eating utensils thoroughly with hot, soapy water.

10.1.3 Water Supply

- 1) All drinking water sources and water tanks should be regularly tested, the results documented, and reviewed to ensure that the water quality meets WHO standards.
- 2) Rainwater is a relatively pure source of drinking water, provided it is not contaminated by animal or bird droppings or by metals from the collection system. Rainwater should be filtered, disinfected and tested just like any other drinking water source.
- 3) Groundwater may be drawn from wells or springs at least 50 m (150 ft.) from sources of contamination such as latrines.
- 4) Surface water from rivers and lakes is prone to pollution by bacteria and larvae.
- 5) Care should be taken that tanker drivers always draw water from the established source and that the tanker itself does not become contaminated.
- 6) Two steps are required to purify water. Disinfection should follow filtration. This is important. Disinfection may be achieved by boiling (water is bubbling) for 20 minutes, by chemical means, or by other methods such as reverse osmosis, ultraviolet light, etc.,

10.1.4 Pest Control

- 1) The kitchen and dining areas attract insects and rodents. Cover all openings with screens. Screen doors, which fit properly with good springs, also help keep out flying insects.
- 2) Yellow light bulbs, fly paper and electric insect killer help control the number of flying insects. Note: Electric insect killers should not be situated over food preparation areas.
- 3) In fly camps where it is not practical to enclose these facilities with screens, protect food from flies and other insects.
- 4) If insecticides are available, use them often to control crawling insects. Use insecticides at least 30 minutes before serving food so that food and drink are not contaminated. Be sure to select insecticides that are safe when used in eating areas.
- 5) Cover all utensils, cups, glasses, plates, serving trays, food preparation surfaces and open food before spraying. Operator should wear appropriate Personal Protective Equipment (PPE) before spraying. A notice for spraying should be posted.

10.1.5 Refrigeration

- 1) Frequent inspections of refrigeration equipment are required to ensure cleanliness. Cleanliness helps the equipment perform better, last longer and maintain proper temperatures.
- 2) If the refrigerators and freezers are not self-defrosting, they should be defrosted and cleaned monthly.
- 3) Cover or wrap food before refrigerating or freezing.

- 4) All cold storage units should have racks or barriers to put the food on to allow the air to circulate and to help to maintain proper temperatures. A maximum -minimum thermometer should be placed in each refrigerator and freezer, and this should be read and recorded at least daily.
- 5) Do not allow the food to touch the floor, walls, lids or doors of the cold storage units as it can get stuck.
- 6) Keep raw foods separate from cooked foods.
- 7) Freezer should maintain temperatures below minus 18 degrees centigrade (0 degrees F); refrigerators should maintain temperatures to 1 to 4 degrees centigrade (34 to 39 degrees F); dry stores should be kept at below 21 degrees centigrade (70 degrees F); hot food servers should be kept above 63 degrees centigrade (145 degrees F).

10.1.6 Containers

Use only glass or plastic food storage containers with matching lids, or cover with foil or plastic wrap. If you should use metal containers, use them only until the next meal (no more than three to four hours). Be sure the containers are covered with aluminum foil or plastic wrap.

10.1.7 Proper Storage

- 1) All uncooked frozen food should be kept at -18°C (0°F). These foods should remain frozen until they are prepared or served. Partially thawed, uncooked food is extremely hazardous to health.
- 2) Do not store precooked meat at 0-3°C (32-37°F) for longer than two days. Do not freeze leftovers. Put leftovers in glass or plastic containers and cover with a tight lid or plastic wrap. Mark the container with the date and time and use the contents within 24 hours. If you do not use them within 24 hours, throw the leftovers away.
- 3) Unopened canned goods should be stored in a cool, shaded, dry area. They will last much longer than canned goods stored in hot areas next to stoves, heaters, or in sunlight. Do not use damaged, dented or rusted can goods. Do not use bloated cans or cans that release pressure when opened. Food should never be stored in an open can – once open place the contents in glass or plastic container if not used immediately.
- 4) Use separate cooler dispensers for juices, tea and water. Do not use open pans with dippers or open-top pitchers. These containers permit insects and dirt to contaminate the liquids, not to mention the germs, viruses and bacteria that are spread by hand contact.
- 5) Perishable food should be kept covered and not be exposed to room temperature for more than an hour. Refrigeration is preferred.
- 6) Fruits and vegetables should be stored in well-ventilated areas and protected from insects, rodents and animals. Do not store fruits and vegetables on floors.
- 7) Immediately discard fruits and vegetables when they start to spoil. If there is only a small bad spot, cut it off and use the remaining part.

- 8) Food should not be stored in the same area as non-food (such as detergents, pesticides, etc.)
- 9) Care should be taken to rotate stored foodstuffs so that expiration dates are not exceeded.

10.1.8 Kitchen Staff

- 1) Persons employed in the preparation, cooking or serving of food or drink or in the handling of eating/drinking utensils should have undergone a medical examination and fulfilled the necessary health requirements. Follow up with periodic exams. They should be free of contagious diseases, cuts, sores and colds when handling and preparing food.
- 2) Check the kitchen staff often to make sure they practice good personal hygiene. They should be shown how to properly scrub their hands with soap and water. (They should keep their nails and hair short.)
- 3) The kitchen staff shall wash their hands prior to the handling of food, after handling uncooked food, or after using the toilet.
- 4) The kitchen staff shall report for duty in clean clothes. If possible, provide them with uniforms, cook's caps and hairnets.

10.1.9 Dishwashing

- 1) Use a spatula or other utensil to rake food from plates. Do not use bare hands because uneaten food is contaminated. (This is a good way to pick up a contagious flu or cold virus.)
- 2) Pre-wash dishes before putting them in the dishwasher.
- 3) If a dishwasher is not available, wash the dishes in a solution of hot, soapy water. There should be two sinks, one for washing one for rinsing.
- 4) To sterilize the dishes add 100 ml (1/3 cup to 1/2 cup) liquid bleach to every five gallons of hot water used for rinsing.
- 5) Air or drip dry the utensils. When they are dry and before storing them, make sure that they are clean. If an item is not clean, re-wash and re-sterilize it.
- 6) Use these sterilization processes after every meal.
- 7) Discard any broken or damaged dishes, glasses or utensils.

10.1.10 Kitchen Tools

- 1) Scrub down the cutting block or boards with a solution of warm, soapy water after each meal. Teach the staff to clean knives, cleavers and can openers, advising them that bacteria can grow in the handles, etc.
- 2) Chopping meat requires undivided attention. The chopping block should be firm, the cutting area of the meat well on the block and the hands and body clear of the line of strike. There should be adequate room for movement and no obstructions in the cutting-stroke path. On transition zone

crews, particular care is required when the vessel is under way or in rough seas. Use of Metal protection gloves is recommended when chopping meat.

- 3) To avoid cross-contamination, do not allow cooked food to come into contact with uncooked food or surfaces used to prepare uncooked food. Do not allow uncooked poultry to come in contact with other foods. Separate chopping boards should be available for raw and cooked meats and vegetables.
- 4) Inspect the kitchen frequently. During frequent use, trash and debris can accumulate in drawers containing utensils. Clean storage areas at least weekly.
- 5) Keep flour, sugar, meal and other frequently used perishable foodstuffs in tightly covered containers.
- 6) Schedule a weekly scrub-down and sanitation of the kitchen. Especially, clean the area behind the stove where grease accumulates. (This is a fire or health hazard.)
- 7) Kitchen staff members with open sores on their hands or fingers should not work in the kitchen.
- 8) A first aid kit containing antiseptic soap, bandages, burn treatment and eye wash should be in every kitchen.
- 9) A fire extinguisher of appropriate type and size and a fire blanket should be conveniently located and accessible in every kitchen. Water should not be used to extinguish fat fires.
- 10) A fire blanket is best for extinguishing a fat or grease fire. If a fire blanket is not available, use a fire extinguisher. Shut off the heat source as soon as possible. Do not attempt to remove the container until it has cooled down to less than 35°C (90°F).

10.1.11 Cooking

Good hygiene practices and food handling procedures should be observed when preparing and cooking food.

- 1) Food should be thawed in the refrigerator, not at room temperature.
- 2) Pork, poultry and fish should be cooked thoroughly.
- 3) Water used for cooking should be of the same standard as drinking water

10.1.12 Garbage Waste Disposal

- 1) Empty the garbage cans after each meal. Rinse them out before returning them to the kitchen. Make sure they are covered with a properly fitting lid. During the weekly scrub-down, clean the garbage cans.
- 2) When garbage is improperly disposed of, it attracts flies, vermin and rodents.
- 3) For biodegradable waste, dig a pit at least 60 m (200 ft.) away from the camp and 2 x 2 x 2 m (6 x 6 x 6 ft.) in size. The pit should be located downhill and downwind from the camp and away from water wells or the camp's water source.

- 4) Non-biodegradable solid waste should be disposed of in accordance to local laws or client requirements.
- 5) Either burn the garbage and refuse or cover it with about five cm (two in.) of dirt each day. Never use gasoline to start the fire. When available, use quick lime to accelerate garbage decomposition.
- 6) All waste disposals should comply with the local environmental requirements.

10.1.13 Waste Water Disposal

- 1) Ideally grey and black water should be separated. Black water should be passed through a septic tank before effluent is discharged into a soak field or waste water collection pit
- 2) Waste water pits need to be 100 meters from camp, and preferably downwind. Care also needs to be taken so that they do not pose a nuisance to the local populace (i.e. smells and filtration).
- 3) All waste water pits should be fenced and signed to avoid unauthorized entry.
 - a. Before excavating any pits, a risk assessment should be carried out and potential hazards, such as drowning or unauthorized public access, be identified and controlled
 - b. Pits are potential drowning hazards to crew and local personnel. Strict management and controls of all excavations should be implemented.

10.1.14 Restoration

- 1) As far as possible, the camp site should be left in the same condition it was found.
- 2) All pits should be adequately filled in
 - a. Special care should be taken so that abandoned pits are properly filled-in, and do not pose an on-going hazard
 - b. All environmental safeguards should be taken when closing waste pits (i.e. prevention of leaching, settling, and visible esthetics).

10.2 Facility and Shop Safety

10.2.1 Lockout/Tagout

Lockout is the process of blocking the flow of energy from a power source to a piece of equipment and keeping it blocked out. A lockout device is a lock, block, or chain that keeps a switch, valve or lever in the off position.

Tagout is accomplished by placing a tag on the source. The tag acts as a warning not to restore energy to or restart the piece of equipment under lockout. Tags should clearly state: DO NOT OPERATE and should be applied by hand.



When maintenance is needed on any electrical powered line, motor, equipment, or fuel-powered engines, you should protect yourself and others from accidental start-ups or turn-ons. Accidents and deaths can occur when someone ‘thought’ the machine or electricity was turned **OFF**.

It is recommended that all operations have a site specific documented lock out/tag out process in place, which identifies the equipment involved and assigns responsibilities.

In a generic Lock Out/Tag Out process, these eight steps may be followed:

- 1) Lockout/tag out is specifically focused on isolating stored energy sources when equipment is being maintained or repaired. It may be part of a Permit to Work system, or be carried out as part of a work instruction.
- 2) All crew members should receive lockout/tag out training. This is often done during induction training, or specific lockout/tag out awareness training.
- 3) Identify all power sources for the project, identify all parts that are to be shut down. This includes identifying all hydraulic and pneumatic systems, spring, compressed air, gravity systems and all electrical circuits.
- 4) Every power source has its own procedure for lockout, which may be accomplished by pulling a plug, opening a disconnect switch, removing a fuse, closing a valve, bleeding the line, or placing a block in the equipment, etc.
- 5) Advise everyone involved that a lockout/tag out procedure is in place.
- 6) Locks should be available to all workers involved, and the lockout apparatus (clips, chains, lockout boxes, etc) should be used to isolate the power source, or prevent the equipment being inadvertently powered up. Any lockout device may only be removed by the individual placing the lock.

- 7) Tags should indicate that the machine, circuit or equipment is out of order and should not be used. Tags should be placed and removed by the person in charge.
- 8) The person in charge should authorize the machine, circuit or equipment being placed back in service.

10.2.2 Working at Height

Height is defined as 2m (6ft), or a lesser height where serious injury may result from a fall (OGP).

Fall protection: A system designed to prevent falls when working at height. Can include edge protection (rails, barriers) or restraint devices (fall prevention harnesses).

Fall arrest: A system designed to arrest a person who has fallen. It consists of an anchor point, connectors, a body belt or body harness and may include a lanyard, deceleration device, lifeline, or suitable combinations of these. The entire system should be capable of withstanding the tremendous impact forces involved in *stopping* or arresting the fall.

- 1) Any work that takes place at 2m (6ft) or above requires adequate fall protection or fall arrest devices and may require a Permit to Work.
- 2) Working at height can also include (but is not limited to): erecting and climbing antenna masts, working on top of tankers and trailers, maintaining air conditioning units by climbing on top of trailer hitches, erecting and maintaining camp fuel tanks and water towers, working on drill rigs and vibrators, etcetera. In all cases a height specific risk assessment should be carried out, and adequate controls implemented, such as fall protection, or fall arrest systems. Special attention should be paid to aggravating conditions, such as slippery surfaces, ice, wind, and reduced visibility.
- 3) If you have to climb, use a ladder or approved access method. Make sure the ladder is designed to support the load it is intended to bear. Face the ladder when going up or down.
- 4) Always look up before positioning the ladder and climbing it. You should then be aware of any restrictions that will get in your way when you make the climb or objects on which you might hit your head.
- 5) A non-conducting ladder is recommended for use when working with electrical tools or any live electrical source. Keep rungs or steps tightened and free from oil, grease, or any slippery substances. All step ladders should be equipped with locking bars and should be locked in place before use. Never stand on the top step or rung of any ladder. If using a straight ladder over 3 m (10 ft.) long or high, tie it off at the top to prevent it from falling backwards or sideways. Secure the ladder on a firm and even surface. If the surface is smooth, use a skid-resistant material on the bottom of the ladder. Discard any ladder that is cracked or bent.
- 6) Extension and straight ladders should be equipped with safety feet and rubber tips to prevent them from slipping.

- 7) Set the ladder's base one-fourth of the ladder's length away from the support against which the top is leaning. Set the ladder firmly before climbing. If necessary, block the bottom and secure the top.
- 8) Do not paint ladders. The paint can hide defects such as cracks. Use a good grade of varnish sparingly or use a mixture of linseed oil and turpentine to preserve the wood.
- 9) Step ladders may not be used as straight ladders.
- 10) When you are on a ladder, do not over-reach; the ladder could slip or you could lose your balance. Get down off the ladder and move it to the proper position.
- 11) Inspect any ladder before use. A-frame step ladders should have spreaders in place before use.
- 12) Both hands are to be used while climbing or descending ladders. Use tool belts or pouches for carrying tools and other small objects. If gloves are worn, they should be of proper fit. Use extra care on ladders if gloves are worn or hands are wet or greasy.
- 13) Working from ladders should be avoided since there is a risk of overbalancing and falling. Where it is necessary, typically when above 2m (6 ft.), a safety harness with a lifeline secured above the position of work should be worn
- 14) If you use scaffolds, make sure all planks and other materials are free from knots and splits.
- 15) Make sure that the scaffolding can support the load it has to bear.
- 16) The flooring or base on which the scaffolding is placed should be firm and even.
- 17) Learn to erect a scaffold from an experienced person.
- 18) Ensure that the ladder or scaffolding cannot come into contact with any overhead power lines or radio transmission lines.
- 19) Planks should not be supported on the rungs of portable ladders used as a staging nor should the ladders be used horizontally for the same purpose.

10.2.2.1 Erecting masts for radio aerials.

The hazards linked to the erecting or dismantling of masts are:

- collapse of the mast by torsion,
- personnel falling while working at height,
- falling objects,
- injuries linked to manual handling ,
- whipping action of parted cables,
- trips and falls over the cables and pegs,
- lightning strikes,
- obstructing low flying aircraft

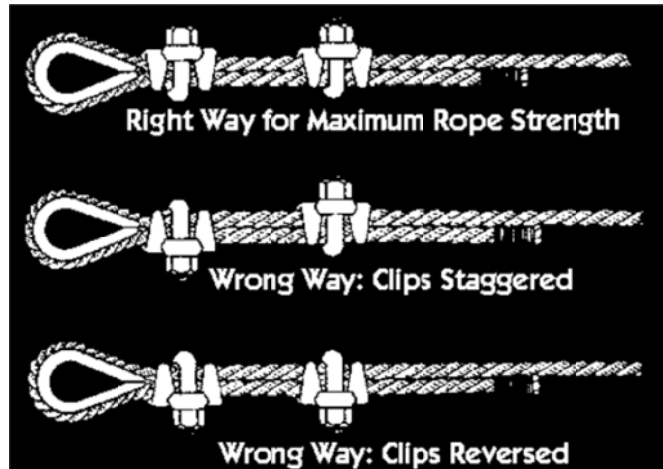
All masts should be supplied with a detailed manufacturer notice and are normally inspected once a week to check for guy wire tightness, (wire rope clips & turnbuckles), grounding (lightening protection), corrosion in wires and anchor stability in the ground. All cables should also be flagged for visibility and in some instances where required should be lighted for aircraft if the height requires this.

For masts above 20 meters, lightning protection is also recommended.

Masts should be mounted far from power lines, at least 1.5 times the mast height; and far from circulations on a flat terrain with a slope below 10°.

Telescopic masts or towers erected with the use of a gin pole are preferred as they do not require personnel to work at height during construction.

Usually, masts over 6 meters have to be guyed by cables (3 or 4), with additional guy wires sets every 6 or 9 meters in average for taller towers. The angle of the guys wire cables may range between 45° from the base guy wires up to 60° on the top guy wires. Turnbuckles may be fitted to adjust the wires to ensure they are taught.



Correct and incorrect methods for using clips and thimbles on wire rope. The saddle of the clip rests against the “live” portion of the wire rope while the Ubolt rests on the short, “dead end” portion of the wire rope. Using clips improperly severely weakens the connection, making it unsafe.

Remember, “Never Saddle a Dead Horse”

Raising and lowering towers may be limited by weather conditions (wind force & lightning).

For tilting masts, the top of the mast is

directed uphill, or with the wind to assist in raising the tower.

There are a few different types of anchors that are most commonly used with towers; screw in “Auger” type anchors, hammer driven “duckbill” anchors, cast concrete anchors and expansion bolts (for use only in solid rock). Pegs (from .50 to 1 meter) or reinforced concrete blocks (buried at 1 meter depth minimum) may also be used for smaller towers. For taller towers a more secure anchor may be required.

What anchor should be used depends on the soil type that the anchors will be placed in. See the following table for suggestions:

Soil Type	Recommended Anchor	Alternatives
Sand	Buried Concrete	None
Loose Gravel	Buried Concrete	None
Loam	Auger	Duckbill, Buried
Clay	Duckbill	Concrete
Rocky Soil	Duckbill	Auger, Buried Concrete
Gravelly Soil	Auger or Duckbill	Buried Concrete
Solid (Soft) Rock	Large, Long Expansion Bolt	Buried Concrete
Solid (Hard) Rock	Smaller Expansion Bolt	Large Eye Bolt + Cement

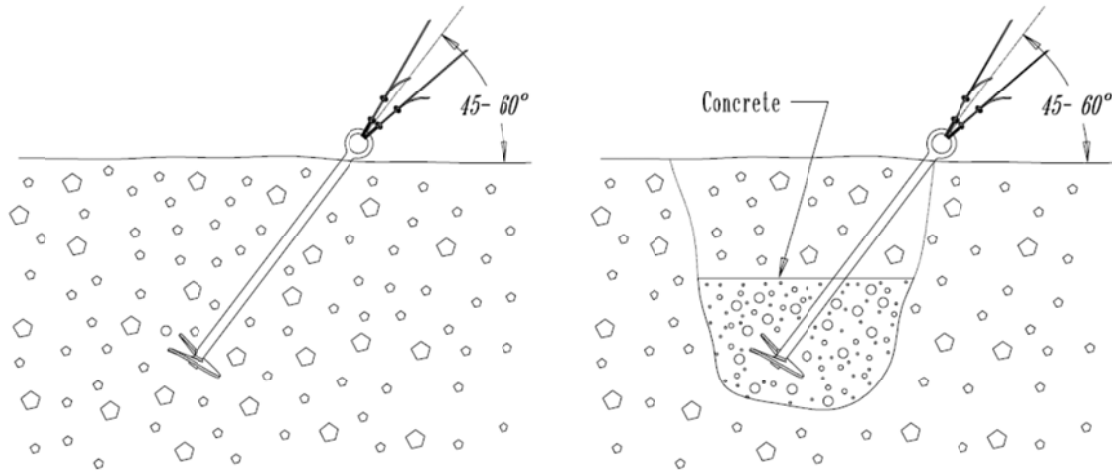


Figure 8 - Auger Anchor

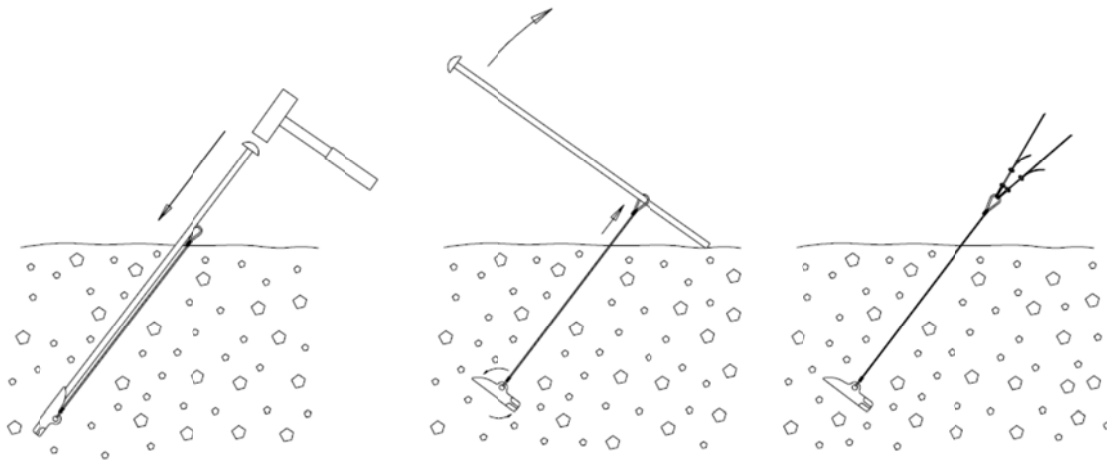


Figure 9 - Duck Bill Anchor

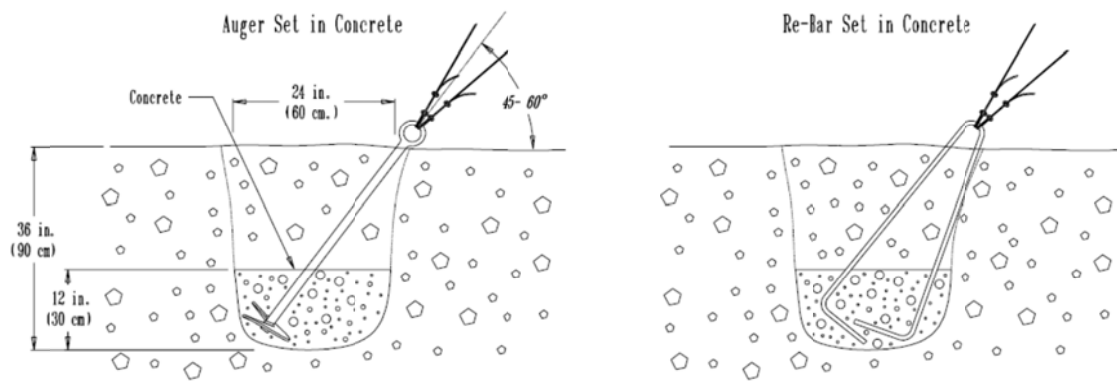


Figure 10 - Auger / Rebar In Concrete Anchor

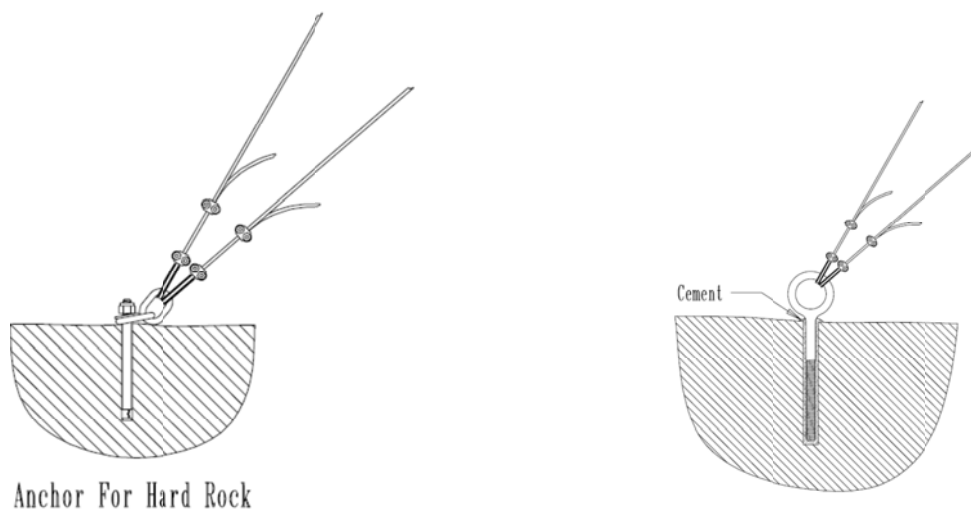


Figure 11 - Anchors for Rock

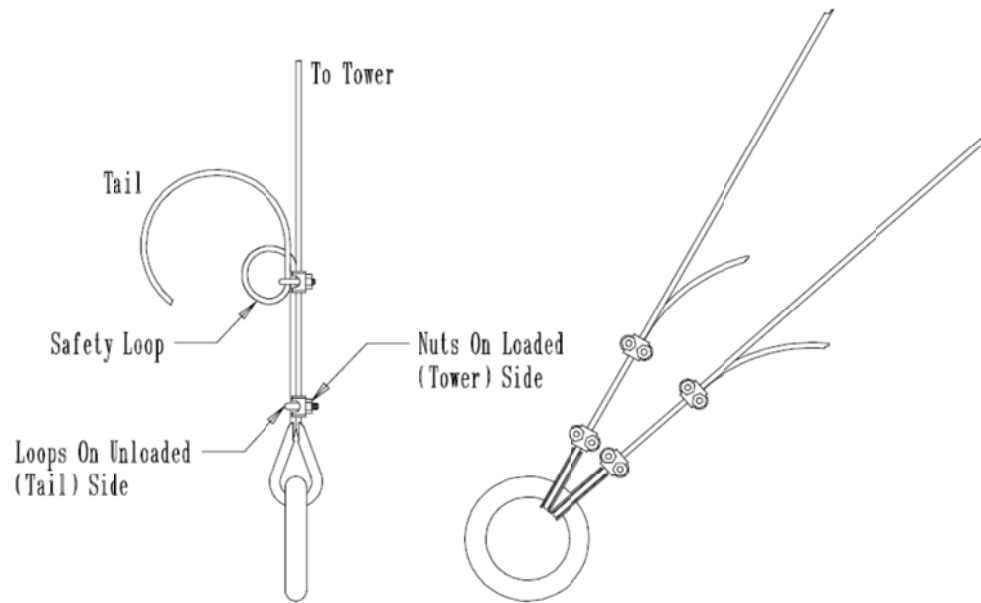


Figure 12 - Guy Wires on Anchor

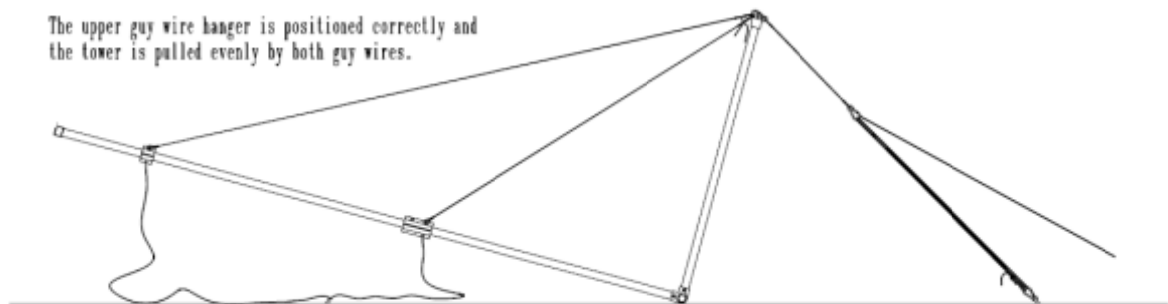


Figure 13 - Use of Gin Pole to Pull Tower Up

10.2.3 Hot Work



Hot work includes welding and cutting, as well as grinding, hot tapping and any other work that generates heat and/or sparks.

Hot work is strictly prohibited by unauthorized persons. The following sections discuss safe work practices for hot work. Welders should be adequately trained and deemed competent.

10.2.4 General Safe Practices

A designated hot work area should be established, where hot work can be undertaken without a fire watch or permit to work. The area should be free of combustible and flammable materials, well ventilated and shielded from view to passers by. Welding and cutting outside the designated hot work area should be kept to a minimum-When welding or cutting on any tank, pump, or line that has contained a flammable substance, extra precautions should be taken to ensure that they are rendered safe before beginning the hot work. Before welding or burning, equipment should be inspected for the following:

- 1) Welding leads should be completely insulated and in good condition.
- 2) Cutting tool hoses should be leak-free and equipped with proper fittings, gauges, regulators and flashback devices.
- 3) Oxygen and acetylene bottles should be secured in a safe place, away from heat and other combustible materials. Stored oxygen bottles should be separated by at least 20 ft (6.1 meters) from any combustible materials or fuels including stored acetylene bottles.

In addition, the following general safety practices apply to most cutting or welding procedures:

- 1) When hot work is necessary outside of the designated hot work area, a permit to work is required and one person should stand as a fire watch with a fire extinguisher. Move welding and cutting operations to the safest practical area.
- 2) Hot work areas should be checked periodically for a combustible atmosphere.
- 3) All employees should wear eye and face protection. Depending on the nature of the work and the proximity of other welders, employees may also need to wear the following as appropriate: fire retardant clothing, hard hat, ear protection and respiratory protection.
- 4) Care should be taken to prevent sparks from starting fires.
- 5) Gas cylinders require careful treatment. Unused gas cylinders should be removed from the welding and cutting area.
- 6) Acetylene regulators should be equipped with flame or flashback arrestors. Only authorized factory personnel can service or repair regulators.
- 7) Hoses should be kept out of doorways and away from other workers. If the hose is flattened, a flashback may occur.
- 8) If flammable gas is detected, welding or cutting operations should be shut down.
- 9) All welding operations should be performed according to authorized procedures.
- 10) Hot metal should be marked with a sign or other warning when welding is complete.

10.2.5 Acetylene (Gas) Welding and Cutting Tools

The following precautions should be taken with gas welding and cutting equipment:

- 1) Only trained and competent employees may use welding equipment.
- 2) Close cylinder valves when work is finished, the cylinder is moved, or the cylinder is empty.
- 3) Repair, replace, or clean, dirty or defective hoses. Do NOT repair or tamper with cylinders, valves, or regulators.
- 4) Do not interchange regulator or pressure gauges with other gas cylinders.
- 5) Keep cylinders in an upright position when in use.
- 6) Never try to transfer acetylene from one cylinder to another.
- 7) Never use cylinders as rollers or supports.
- 8) Never use a match to ignite a welding torch. Always use an approved igniter.
- 9) Never heat a cylinder to raise the pressure.
- 10) Acetylene cylinders should be stored in an upright and secure position, with the discharge valve closed and the protective valve cover screwed on.

10.2.6 Controlling Sparks and Heat

Control heat, sparks and slag when performing hot work:

- 1) Cover cracks, holes and openings with fire retardant material. Take precautions to protect people and equipment below the work site.
- 2) Check both sides of a partition before welding on it. Remove any combustibles.
- 3) When working in enclosed spaces, place all cylinders and welding machines outside.
- 4) Do not open equipment, piping, or containers with flammable materials adjacent to a welding area.
- 5) Weld upwind of potential vapor releases.

10.2.7 Electric Welding and Cutting Tools

The following precautions should be taken with electric welding and cutting equipment:

- 1) Store arc welding tools in areas free from combustible vapors.
- 2) Hood or screen arcs.
- 3) Wear eye protection.
- 4) Ground the frames or cases of arc welding equipment.
- 5) Keep welding cables away from passageways to prevent trips and falls.
- 6) Welding cable with damaged insulation or exposed conductors should be replaced.
- 7) Avoid contact with grounded circuits when changing electrodes.

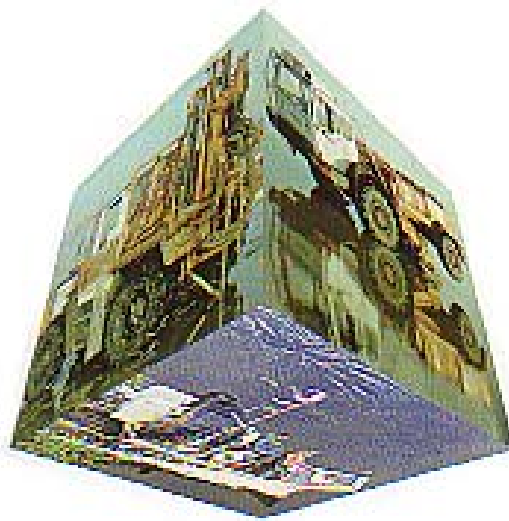
10.2.8 Permits and Supervision

A Permit to Work process should be in place for all hot work that takes place outside the designated hot work area.

Only authorized supervisors can sign a hot or safe work permit for hot work procedures.

A fire watch (a person with appropriate Personal Protective Equipment (PPE) and a fire extinguisher) should be assigned to each welding or cutting project outside the designated hot work area.

11. AIRCRAFT



11 AIRCRAFT

11.1 Helicopter Operations



Helicopter operations should be organized taking into account the daylight hours, the weather conditions, the area dependent factors and the number and type of helicopters available.

The helicopters should be back to base before sunset, with sufficient time (one half hour to an hour depending on distances to the work site) to organize a man search in case of an incident.

All personnel should receive training in the basic rules for helicopter safety. This briefing should include the locations of survival equipment and a brief explanation of the emergency locator transmitter.

Helicopters have enabled us to work in normally inaccessible areas. Since safety depends on communication and education, safety meetings should be held frequently with all crewmembers. Each new crewmember and visitor should receive a complete safety briefing before beginning any operational work with or around helicopters. It is essential to have a good understanding of possible hazards and to follow safe, consistent practices when using helicopters.

There are two rotor assemblies on a helicopter: the main rotor and the tail rotor.

The main rotor rotates in an almost horizontal plane. It provides the lift required for flight and, therefore, creates a strong rotor wash on takeoff and landing. On flat ground, the main rotor blades can also 'droop' dangerously close to the ground on landing and when the helicopter is being shut down. This blast of air can blow hard hats, plywood, sheet metal or any other lightweight material around a landing area causing injury to people and damage to the helicopter. On slopes, the main rotor may come very close to the ground on the uphill side of the helicopter, making a departure to the uphill side extremely hazardous.

The tail rotor is a high-speed propeller and, unlike the main rotor, is almost invisible when operating. It operates perpendicular to the ground at chest height and has its own rotor-wash. All these factors, plus the fact that people are not accustomed to a propeller on the tail of an aircraft, make the tail rotor extremely hazardous.

Stay in direct eyesight of the pilot at all times and approach the helicopter as directed by the pilot. Never approach from the rear.

11.2 Maintenance of Helicopters

- 1) The owners and operators of the helicopters should comply with all manufacturers' and government regulations covering repairs and maintenance of the helicopters.

- 2) Maintenance records should be available for inspection prior to start-up of all helicopter operations, and reviewed by a competent aviation auditor.

11.3 Fueling Operations – Helicopters

Fire Retardant Clothing should be worn by the dedicated fuelling person at all times while fuelling helicopters.

- 1) Fuel pumps, hoses, nozzles, motors and fuel pump filters should be of the type manufactured for fuel operations. In case of a leak in the hose, it should be repaired with material manufactured for this purpose.
- 2) Electrical systems are to be grounded.
- 3) Fuel hoses and nozzles should meet regulations.
- 4) Nozzles and fittings should be of non-sparking material.
- 5) Fuel storage should be at least 15 m (50 ft.) from any power source (electrical power supplies, switch boxes and transformers).
- 6) The area around fuel storage is to be kept free and clear of all dried grass and weeds for at least 8 m (25 feet).
- 7) Fuel storage areas should be surrounded by secondary containment systems or earth berms lined with seamless, impervious material and be of sufficient volume to fully contain the fuels stored plus a freeboard excess of 10-50% depending on local requirements. No smoking is allowed within 15 m (50 feet) of fuel storage and while refueling is in progress.
- 8) An approved fuel filtering system with effective water and contamination separation should be used in conjunction with the fuel storage and refueling facilities.
- 9) Fire extinguisher should be within 25 m (75 feet) of each fuel pump or dispenser.
- 10) Dispose of fuel tank samples in an environmentally acceptable procedure.
- 11) During the aviation risk assessment, consideration should be given to specialized PPE, including the use of flame retardant clothing (FRC), ear protection, eye protection, chemical resistant gloves for fuel handling, etc.

11.4 Crash Kits

Suitable crash equipment should be available in the base camp or staging areas, in addition to firefighting equipment. This equipment should be kept in a crash box, suitable for rapid deployment in the vicinity of the base camp / staging area (carted). Where more than one helicopter is in operation, this same crash equipment should be available for rapid loading into one of the helicopters, for transport to a remote crash site. Crash equipment can include:

- 1) Fireman type axe

- 2) Large axe
- 3) Heavy duty hacksaw with 4 spare blades
- 4) Grab hook with long handle or 30 meters of 10mm non plastic rope
- 5) Heavy duty crowbar of 1 meter length
- 6) 24 inch (61 cm) bolt cutters
- 7) 2 Pairs flameproof gloves
- 8) 2 Torches (flashlights) with spare batteries
- 9) 10 Inch adjustable spanner/wrench
- 10) 2 Fire blankets
- 11) Wire cutting pliers
- 12) 1 Set assorted screwdrivers
- 13) Straight metal ladder (8 ft minimum)
- 14) Harness knife with sheath

Consideration should also be given to other life-saving equipment that might be required depending on terrain and access, such as:

- 1) Come-along puller
- 2) Chain-saw
- 3) A trauma first-aid kit (if one does not already exist)
- 4) A basket stretcher
- 5) Space blankets
- 6) Signaling mirrors
- 7) A radio set with crew frequencies (and/or satellite telephone)

11.5 Landing Zones - Helicopters

Contractors, clients and helicopter pilots should define the parameters for landing areas in order to allow for efficiency of operations and safety.

- 1) The pilot's judgment as to suitability for flight is final.
- 2) Landing areas should be kept clean and clear of all obstructions to allow for maneuvering of helicopters.
- 3) All wires, ropes, antennas, etc., are to be well-marked and never erected near the landing area or approaches to the landing area.

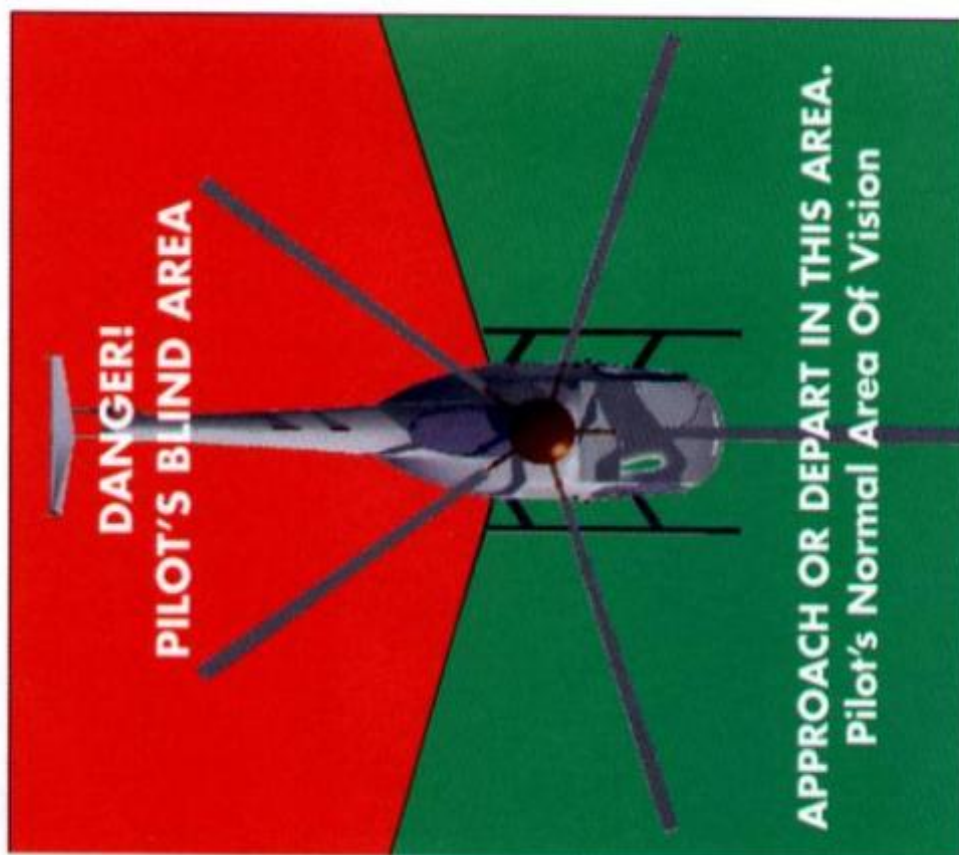
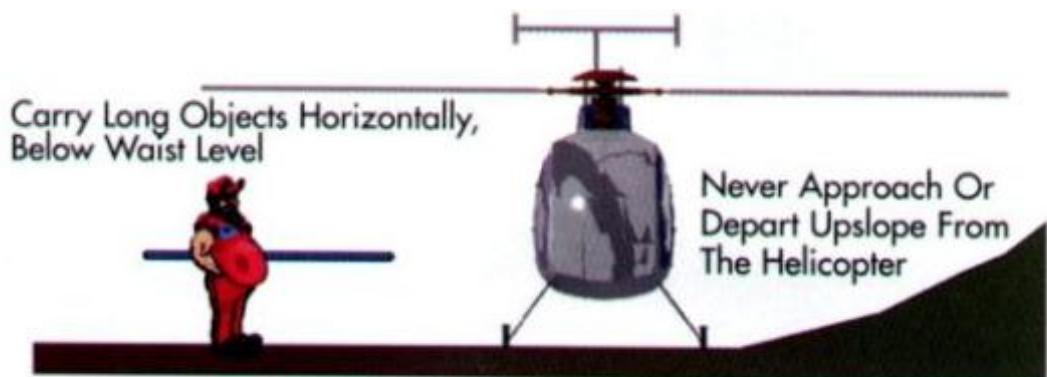
- 4) Fly camps should be built at sufficient distance from the landing zone due to the downdraft of the helicopter, or a potential hard landing. Loose objects like tents or bags should be secured such that the helicopters' down drafts do not affect them.
- 5) Keep the approach and departure paths into a Landing Zone (LZ) clear of people and vehicles and allow for possible changes in paths as the wind changes. Wind direction indicators should be set up at all frequently used Landing Zones (LZs).
- 6) It is important that the pilot know the wind direction and velocity before takeoff. You can help by tying a windsock, flagging or flag in a conspicuous place on the edge of the Landing Zone (LZ).
- 7) Pilots should be able to approach or depart the LZ with external loads without flying over people, equipment, vehicles, or houses.
- 8) When selecting a new Landing Zone (LZ), choose one that is as flat as possible and has adequate clearance in several directions. Never pick a Landing Zone (LZ) in a hollow or depression. When calling a helicopter into a new or improvised Landing Zone (LZ), give a detailed description of the zone and all hazards around it, as well as the wind direction.

11.6 Pilots and Ground Crew

- 1) All pilots should be currently licensed and have a current physical examination certificate.
- 2) Ground crew members should be physically fit to perform their required duties and trained and designated specifically as ground crew member.
- 3) Pilots and ground crew should observe rest rules and not operate aircraft unless they are properly rested to be alert while on duty.
- 4) No pilot or ground crew member may report for duty under the influence of alcohol, after taking any drug - legal or illegal - that impairs their judgment and coordination.

11.7 Passengers

Transporting passengers in a helicopter can be the most dangerous part of such operations when crewmembers are not familiar with boarding and disembarking procedures. No one is to ride in a helicopter without a briefing from qualified personnel.



11.8 Passenger Guidelines and Information

When approaching and boarding a helicopter, take the following precautions:

- 1) While the helicopter is landing, stay in one group. Approach the helicopter from the front, never from the rear.
- 2) Hold your hard hat in your hand, unless you are using a chin strap and securely hold any small or loose articles. Never carry loads above your shoulder.
- 3) Do not walk uphill when leaving the helicopter or downhill when approaching the helicopter. Walk under helicopter blades in a crouched position. Blade tips may droop and come within 1.5 m (5 ft.) of level ground.
- 4) If the only way to board the helicopter is from the uphill side, the helicopter should be shut down and the rotor blades stopped.
- 5) Open and close the helicopter doors gently. Never let the doors swing freely. They should always be hand-held while open.
- 6) When all passengers are buckled in and all doors closed properly, signal the pilot that all is secured.
- 7) Any crewmembers near the Landing Zone (LZ), but not boarding the helicopter, should ensure that all doors and panels are fastened with no loose gear hanging from the helicopter.
- 8) Longlines or any other external lines should not be attached to a helicopter while it is carrying passengers.
- 9) Smoking is not allowed.
- 10) Seat belts should remain fastened at all times and passengers should not change seats.
- 11) Crewmembers should inform the pilot of any hazards in flight, such as other aircraft, something caught on the skids, etc.
- 12) Hearing protection is highly recommended for all passengers.
- 13) When the helicopter is approaching for landing, remain seated and do not unfasten seat belts until told to do so by the pilot.
- 14) When exiting the helicopter, refasten the seat belts behind you and close the doors properly. Disembark only upon signal by the pilot.
- 15) Stay together and depart in the pilot's field of vision. If on uneven terrain, exit to the downhill side or as instructed by the pilot.
- 16) The last crewmember to depart the helicopter should ensure that all doors are closed properly and that no loose tie downs or equipment are hanging from the helicopter. Signal the pilot that all personnel are clear.

- 17) Each passenger should have a flotation device or life vest if flying over water. Non-inflatable life vests or inflated inflatable vests should not be worn inside the aircraft.
- 18) Passengers should be shown the location of first-aid kits and fire extinguisher on the aircraft.
- 19) No person shall ride the sling, longline stretcher or basket for any reason other than a life or limb emergency situation.
- 20) Caution: Let the hook touch the ground to discharge static electricity built up during flight. All tag lines should be short enough that they will not be drawn up into the rotor blades.

11.9 Pilot Briefing Guide

Use the following topics as useful headings for a pilot briefing guide for first time and inexperienced workers.

- 1) General Helicopter Safety
- 2) Helicopters and Hazards.
- 3) Terrain and Landing Zone (LZ) Preparation.
- 4) Passenger and Equipment Loading.
- 5) Enroute - Rules and regulations while in the air.
- 6) Unloading.
- 7) External Operations.
- 8) Hazardous Materials.
- 9) Rescue/Emergency Operations.
- 10) The location of first-aid kits, fire extinguishers and survival kits

11.10 Equipment Loading

Loading equipment takes planning and caution. It should be directed by the pilot according to the following rules:

- 1) Any equipment carried in the cabin should be tied down or, if small enough, securely held by crewmembers.
- 2) Poles or tall objects should be carried horizontally and close to the ground.
- 3) If equipment is loaded into a cargo compartment, it should be secured so that it will not move around in flight. (When working around cargo compartments, be very careful of engine exhaust and the close proximity of the tail rotor.)
- 4) Never load any hazardous materials (flammables, explosives, toxins, corrosives) without the pilot's knowledge and permission.
- 5) After unloading equipment, ensure that all tie-downs are properly secured.

11.11 Longline and Sling Load Operations



Longlines require competent people who thoroughly know the equipment used and have a working understanding of procedures employed.

- 1) Each time the helicopter lands and shuts down the longline needs to be disconnected.
- 2) Never use more than the absolute minimum number of people to hook lines and loads to the helicopter. All other people are to be clear of the area in use in order to allow room for the helicopter to land in case of an emergency.
- 3) One person at each site should be designated as signal person and should be familiar with universal helicopter hand signals and/or have a radio.
- 4) People working under the helicopter should wear gloves, a hard hat with chin strap and goggles for protecting the eyes from blowing sand, rocks, etc. The persons handling the hook are to inform the pilot of the type of load and any special conditions.
- 5) After hooking a load to a longline, do not turn your back or take your eyes off the load. As the load is being carried away, do not walk underneath it. Be sure to inform the pilot of any difficulty you may see, such as catching on limbs or loads coming loose. Watch your footing.
- 6) If assistance is needed in order to unhook a load, always let the load touch the ground first. Do not approach the load if it is swinging excessively and never get under it. Avoid becoming trapped between a swinging load and a fixed object on the ground.
- 7) Static electricity is always present with helicopters and the amount of charge carried depends on the size of the helicopter and the atmospheric conditions (snow, blowing sand, etc.). Always let the hook, load, or tag line touch the ground first to dissipate the charge and stabilize the load. Never use long lines within 100 m (300 ft.) of high voltage lines and never when thunderstorm activity is in the immediate area.
- 8) Passengers should not be carried during longline or sling load operations.

11.12 Fire Prevention and Fire Fighting Equipment

- 1) Each main base helipad should have a combination of foam, dry chemical or CO2 extinguishers for a total capacity of 45 kg (100 lb.).
- 2) Crewmembers should receive training in the use of all fire-fighting equipment.
- 3) The helipad should be kept free of fire hazards. Clean up fuel spills immediately. Repair or replace all leaky fuel hoses. Post No Smoking signs in appropriate languages where they can be seen when approaching the helipad.
- 4) Hot fueling should only be carried out by the pilot or helicopter mechanic. No passengers should be on board and the main fire extinguisher should be manned and ready.

11.13 Transporting Explosives by Helicopter

Explosives and detonators should normally not be transported together.

However, small quantities of non-mass detonating caps (100 or less) can be carried inside the aircraft provided they are packaged in an approved Faraday cage blast absorbing container (wood-lined metal cap box). In such circumstances a releasable external load of explosives may be carried.

Small quantities of non-mass detonating caps and high explosives can be carried together as an external load provided they are packaged in an approved container (detonators in a Faraday box, explosives in day box).

Provided that the detonators are carried in their original packaging and inside approved containers ensuring Faraday cage protection, it is considered safer to continue radio communications and flight following than to impose radio silence.

Bulk high explosives should be carried as external load. Where flights carrying high explosives as external loads need to be over water, it is strongly recommended that a non-floating product is used that self-destructs within a reasonable time when in contact with water (1 year).

Government regulations and company requirements should be reviewed with the aircraft operator in a pre-planning meeting. The pilot is the person in command and should be the person to give approval to transporting explosives and explosive material. It is extremely important that the pilot be notified before explosive materials or detonators are placed aboard the helicopter. All members of the crew should be briefed and documented. There should be no deviation from the agreed procedure.

11.14 Transporting Other Hazardous Materials

- 1) Batteries and power sources shall be carried in a container or protected so as not to allow terminals to contact the aircraft body or any metal object that could cause sparking. Batteries should be secured to prevent accidental spillage of battery acids.
- 2) Any object with sharp points, such as loading poles, should not be carried in a position where the points could cause injury to crew, passengers, or damage the helicopter.

- 3) Fuel of any kind may not be carried in any leaking container. All containers should be approved for the type of fuel and have properly fitting lids or caps.
- 4) All hazardous materials should be identified by name and the hazard identified, (e.g., flammable, explosive, corrosive, toxic, etc.).
- 5) Government regulations and company requirements should be reviewed with the aircraft operator in a pre-planning meeting. The pilot is the person in command and should be the person to give approval to transporting hazardous materials. It is extremely important that the pilot be notified before any hazardous materials are placed aboard the helicopter.

Helicopter Hand Signals

Move
Right



Left arm extended horizontally;
right arm sweeps upward to
position over head.

Hold
Hover



Executed by placing
arms over head
with clenched fists.

Move
Left



Right arm extended horizontally;
right arm sweeps upward to
position over head.

Takeoff



Right hand behind back;
left hand pointing up.

Move
Forward



Combination of arm and hand
movement in a collecting motion
pulling toward body.

Land



Arms crossed
in front of body and
pointing down.

Move
Rearward



Hands above arms, palms
out using a noticeable
shoving motion.

Move
Upward



Arms extended, palms up;
arms sweeping up.

Release
Sling
Load



Left arm held down away
from body. Right arm cuts
across left arm in a slashing
movement from above.

Move
Downward



Arms extended,
palm down; arms
sweeping down.

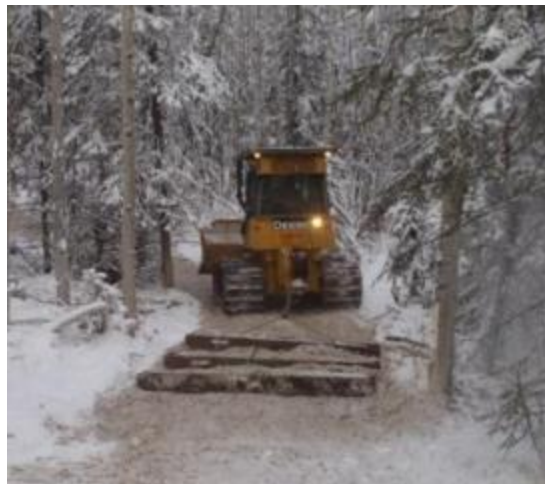
11.15 Air Travel

A minimum survival pack shall be on all aircraft flying over uninhabited country. A radio beacon Electronic Location Transmitter (ELT) or equivalent should be available on the aircraft.

As a minimum, the pack should consist of the following items:

1. Sufficient food to sustain life for an extended period.
2. One axe or hatchet.
3. Fishing gear.
4. A knife.
5. Two boxes of waterproof matches.
6. A mosquito net for each occupant.
7. Signal devices (mirror).

12. Bulldozers & Other Line Clearance Machinery





12 BULLDOZERS AND OTHER LINE CLEARANCE MACHINERY

12.1 General Guidelines

Warning: Before beginning any repairs or maintenance, care should be taken to lock out, tag out, block or otherwise protect personnel from moving parts and stored energy, and assure that the equipment cannot be inadvertently placed into operation.

- All equipment should be locked out from unintentional movement when not in care and control of the operator.
- Equipment or Vehicles unit should be in park and shut off when completing any fuelling and/or maintenance operations.
- During maintenance procedures for pre-start up, equipment and vehicles should be parked with extra clearance.
- Consider installation of secondary safety features to lockout hydrostatic drive levers when the operator is not in the driver's seat. This safety feature would provide an extra control to the park mode.

Each machine of this type should have the following safety equipment:

- 1) Overhead protection canopy to withstand rollover. (Never weld on, modify, drill into or alter rollover protection without consulting with the vehicle manufacturer.)
- 2) Automatic reversing alarm with intermittently sounding tone that is audible above the engine noise from any position around the vehicle.
- 3) Rearview mirror and/or cameras to eliminate blind spots.
- 4) Functioning parking brakes and gear lock to prevent accidental / unintentional movement of the equipment. A switch engineered into the unit that prevents movement when the operator leaves or dismounts the equipment is preferred.
- 5) Hearing protection for equipment drivers where the audible noise level is greater than 85 dB(A).
- 6) Seat belts.
- 7) First aid kit and fire extinguisher.
- 8) In areas where bees or other insect hazards exist, a closed cabin is needed to protect the operator.
- 9) If operations are conducted in swampy or muskeg conditions where there is potential for sinking then an escape hatch in the roof is recommended.
- 10) Immediate access to a functional radio with crew frequencies.

Operators of this type of heavy equipment should follow these safety procedures:

- 1) All drivers should be competent, properly qualified and tested by a qualified supervisor prior to operating heavy equipment.
- 2) Know the width of your attachments so proper clearance can be maintained when operating near fences, boundary obstacles, etc.
- 3) Do not wear loose clothing or jewelry that can catch on controls or other parts of the machine.
- 4) Hard hats should be worn by the operator and the assistant where overhead hazards exist.
- 5) Seat belts should be fitted and worn at all times.
- 6) All protective guards and covers should be secured in place on the machine.
- 7) Keep the machine - especially the deck, walkways and steps - free of foreign material, such as debris, oil, tools and other items that are not part of the machine.
- 8) Secure all loose items, such as lunch boxes, tools and other items that are not part of the machine.
- 9) Know the appropriate work-site hand signals and who gives them. Accept signals from one person only. This person should be familiar with universal hand signals (reference chart).
- 10) Do not allow unauthorized personnel on or near the machine.
- 11) Mount and dismount the machine only where steps and/or handholds are provided. Always use 3 point contact.
- 12) No sleeping is permitted underneath equipment.
- 13) No one is allowed to stand on the tracks unless the machine is in neutral with the brake set or the engine is stopped.
- 14) The operator is to check condition of the winch rope.
- 15) The operator is to check engine oil level, water, battery and tire pressure (where applicable).
- 16) A schedule for periodic walk around should be set to check for oil and fluid leaks
- 17) The operator is to immediately report any deficiencies to the supervisor.
- 18) When operating the equipment, the operator is to have good all-around vision and ensure that the vehicle is out of the path of falling obstacles.
- 19) The operator is to ensure that all personnel are at a safe distance from the machine and, in particular, out of the reach of toppling trees.
- 20) When leaving the machine, the operator should lower blade and attachments to the ground, apply parking brakes, place machine in neutral gear and lock gear lever to prevent accidental machine movement.

- 21) Park on level ground, stop the engine and switch off the master battery switch.
- 22) Machines should be serviced in accordance with maintenance schedules and kept clean.
- 23) All line clearance work should be pre-programmed. The operator should not deviate from the pre-programmed work schedule without permission.
- 24) Hazard mapping should be conducted prior to clearing activities to identify potential hazards such as sink holes, steep drop offs, oil & gas pipelines, electrical power lines, archeological sites, and other manmade structures.
- 25) Operators should have knowledge of all safety items available on the plant, i.e. Fire Suppression systems, machine guards, safety trips and shutdowns, etc.
- 26) Ideally a spotter should be used when reversing, and to check ahead for hazards and obstacles where the operator does not have a clear field of vision, or there is a risk of shallow buried hazards (pipelines and pipeline risers, utilities, etc).
- 27) Use extreme caution when working near bulldozers and woodgators and obey minimum approach distances, as defined by the crew hazard assessment for the type of equipment being used.
- 28) Be aware of vehicles parking directly behind bulldozers and other heavy vehicles that maybe obstructed from view. Vehicles should not park behind.
- 29) Before approaching a machine the person approaching should communicate his intention with the operator. After receiving a positive acknowledgement, stay in direct eyesight of the operator at all times and approach the machine as directed by the operator.

12.2 Mulcher Operations

The following outlines procedures that should apply to all mulcher operations and that should be followed by operators and mulchers accordingly. Reference Geophysical Mulcher Operations - CAGC BEST PRACTICES

12.2.1 Operators

- 1) Only operators who are authorized by the Employer and who have received training from the Employer should be allowed to operate a mulcher.
- 2) Footwear should be free of grease, mud and snow prior to climbing onto a mulcher.
- 3) The operator should have proper protection for eyes, ears, face and body when outside the cab.
- 4) The mulcher operator should have proper headgear (approved hard hat) when exiting the machine and be aware of overhead hazards created by flying debris.
- 5) The operator should perform regular walk-around inspections throughout the workday.
- 6) Windows should be checked regularly for cracks and kept clean.

- 7) The operator should be aware of all workers or other people that are near mulchers in operation.
- 8) The operator should wear a seatbelt when operating the mulcher.
- 9) The mulcher should be escorted when accessing on public roads.
- 10) When backing up a mulcher, a signal person should be used wherever possible. Backup alarms are normally required on any mobile equipment when the operator's rear vision is obscured
- 11) There should be 3 meters between machines when they are parked.
- 12) Passengers are not allowed to ride on or in a mulcher, unless it is equipped by the manufacturer to carry passengers.
- 13) The mulcher should be blown out regularly with an air hose to remove dust and debris. This is especially a concern in the engine compartment where a fire may start.
- 14) The operator should recognize and mark hazards encountered or created by the mulcher (i.e. damage to trees requiring dangerous tree control measures).
- 15) The operator should ensure that any tree sustaining partial or full damage to the main trunk from the mulching operation will be felled by the mulcher or marked as a hazard.
- 16) All known hazards should be communicated immediately to any person who may be affected by the hazard and to those persons responsible for taking corrective actions.
- 17) All hazards should be reported as soon as possible to the supervisor.

12.2.2 Mulchers

- 1) When a mulcher is cutting (i.e. drum is spinning), no person should be allowed within 100 meters or 2 tree lengths, whichever is greater, in any direction of the machine.
- 2) Mulchers should display visible signage requiring that all persons keep away at least 100 meters away while the machine is at work.
- 3) Mulchers should be fitted with positive shut-off devices and back-up alarms.
- 4) Mulchers should be fitted with a secondary escape system (e.g. escape hatch). Mulchers without a secondary escape hatch may not be allowed to operate in some areas such as wet terrain.
- 5) Mulchers should be equipped with firefighting equipment as required by the applicable fire suppression regulations, (examples include shovel, water bucket, fire extinguisher and First-aid kit).
- 6) Mulchers should be equipped with a radio that contains a channel(s) on the same frequency as that of the crew.

- 7) Mulchers that are equipped with a factory installed fire suppression system can only be operated when the system is functional.
- 8) All emergency shut-off systems should be functional at all times.

12.2.3 Operations

- 1) A 'team plan' should be developed for each project so that mulcher operators maintain good communication with support slashers / fallers and other crew personnel (e.g. surveyors, preflagging personnel).
- 2) Doors should be closed during normal operation on solid terrain to ensure that flying chunks of wood and metal do not hit the operator. Mulchers have a high-speed drum mounted on the front of the machine. As a result, debris from this drum can be thrown at high speeds in all directions. Debris from the mulcher can be as small as splinters and as large as fire wood blocks.
- 3) The mulcher should be accompanied at ALL times by two slashers complete with support units (e.g. Argo's).
- 4) The operator should avoid cutting trees that are too large, as per the manufacturer specifications for the particular mulcher that they are operating.
- 5) In the event that trees must be cut by slashers, they should follow "safe falling procedures" as per legislation and industry standards applicable to the area within which they are working.
- 6) When cutting "dog legs" in lines intersecting with roads, slashers / hand cutters should first cut a line of sight, then retreat to a safe area (100 meters away) before the mulcher resumes mulching operations.
- 7) Slashers and operators should follow industry recommended practice / their companies safe operating procedures for "dangerous tree control".
- 8) When any person is approaching a mulcher from any direction, that person should notify the operator by radio so that the operator is aware of his/her presence. Confirmation from the operator should be acknowledged and the machine put on standby mode (drum disengaged) before any close approach. NO EXCEPTIONS!!
- 9) Operators should make radio checks with the support slashers at regular pre-designated intervals and slashers/operators should also maintain normal operating procedural radio checks with the Medic at regular pre-designated intervals.
- 10) All "communication system checks" should be made prior to commencement of operations. Should communication between support slashers and operator breakdown; operations should cease until communications can be re-established.
- 11) Communication protocols should satisfy the Working Alone procedures for all mulcher operations.

- 12) When doing repair and maintenance work on units, the key for the power plant should be removed from the ignition to prevent the drum from rotating.
- 13) Keys should be clearly marked, identifying what they control.

12.2.4 Key Personnel Responsibilities

12.2.4.1 Employer

An employer is responsible for:

- ensuring that the mulcher operator is properly certified to operate the mulcher. This includes verification of necessary certification (e.g. First Aid)
- knowing and understanding the applicable regulations and codes for the seismic industry and the safe operating procedures for mulchers
- ensuring that the mulching units meet or exceed all standards in relation to safety equipment, first aid supplies, placard and signage, emergency shut downs and guard
- mechanisms through equipment audits

12.2.4.2 Mulcher Operator

A mulcher operator is responsible for:

- the safe working operation of a mulcher
- having knowledge and understanding of the applicable regulations and codes for the seismic industry and the safe operating procedures for mulching
- ensuring that the mulcher meets or exceeds all standards in relation to safety equipment, first aid supplies, placards and signage, emergency shut downs and guard mechanisms
- ensuring that the mulcher is in a good state of repair and in safe operating condition
- ensuring that his or her physical condition is such that he or she is capable of
- operating the mulcher without risk to his or her own health and safety or the health and safety of others. (i.e. not under the influence of alcohol or drugs whether or not they are prescribed)
- ensuring that no new hazards are introduced into the worksite that might endanger other workers or any other person
- ensuring that all trees are completely felled or properly marked with their location identified and communicated to the supervisor and all other affected workers
- maintaining the prescribed safe working distances from other workers and other machines

12.2.4.3 Slasher / Faller

Slashers / Fallers working in support of a Mulcher are responsible for:

- the safe working operation of all of their equipment (e.g. chainsaws)

- knowing and understanding the applicable regulations and codes for the seismic industry and the safe operating procedures for falling, slashing and mulching
- ensuring that their equipment meets or exceeds all standards in relation to safety equipment first aid supplies, placards and signage, emergency shut downs, guard mechanisms
- ensuring the chainsaw is in a good state of repair and in safe operating condition
- complying with all PPE (personal protective equipment) policies and regulations
- ensuring that their physical condition is such that they are capable of operating their equipment without risk to their own health and safety or the health and safety of others. (i.e. not under the influence of alcohol or drugs whether or not they are prescribed)
- maintaining the prescribed safe working distances for themselves and all other workers and machines

12.2.5 OPERATING HAZARDS

12.2.5.1 *Fire Potential in Dry Conditions*

The following identified hazard is based on an actual incident that occurred on a seismic program.

In dry conditions, impacts from the drum or blades of a mulcher on rocks can create sparks that may cause ignition of a fire to tall grass and brush.

Precautions should be applied when working in dry conditions and a plan should be developed to include the following provisions:

- 1) Mulchers should be equipped with shovels, water cans, extinguishers, axes and other firefighting tools necessary to immediately deal with a fire situation.
- 2) Equipment should be tested (i.e. fire extinguishers charged) and operators trained in their use.
- 3) Information should be provided to the operator about access to, and location of, a proximate water supply.
- 4) Emergency contact lists and a response plan 'ERP' that includes names and telephone numbers should be on-board the mulcher (i.e. for Fire Marshall, Police, Ambulance, Client Representative, Crew Supervisor, Landowner and other relevant personnel).
- 5) In the event of a fire, the area should be monitored for re-ignition.

12.2.5.2 *Working in Soft Terrain*

When working in areas of soft terrain, in slightly frozen winter conditions or any area where there is the potential for breaking through ice or muskeg (i.e. beaver dams that are difficult to identify under snow accumulations and with snow clouding created from the action of the drum), the following guidelines should be observed.

- 1) Operators should be trained in the operation of Mulchers on soft terrain.

- 2) Operators should be familiar with, and trained in the weight specifications of the mulcher; and ice thicknesses.
- 3) Companies should develop safe work procedures to deal with situations such as breaking through soft muskeg, beaver dams, etc. It is also the Employer's responsibility to train operators according to such procedures.
- 4) While crossing any soft terrain, always ensure that the operator has a functional means of escape should the mulcher sink far enough to block the doors from opening.
- 5) Mulchers not equipped with a secondary escape system should avoid all soft terrain or ice. Note: The drum should not be engaged (i.e. spinning) while the door is open.

12.2.6 EQUIPMENT HAZARDS

12.2.6.1 *Escape Hatches*

Some operations require that ALL mobile equipment with a single cab entrance door should be equipped with an alternate means of escape. This regulation may also outline the location and size of this escape system.

Mulchers with a single cab entrance that are NOT equipped with an escape hatch or alternate escape system should NOT operate in areas of soft or slightly frozen winter conditions or any area where there is the potential for breaking through ice or muskeg (i.e. beaver dams that are difficult to identify under snow accumulations and with snow clouding created from the action of the drum).

12.2.6.2 *Lexan Windows*

A Lexan (polycarbonate sheet used in heavy equipment) window may in some cases be used as a substitute for bar guards. In this application it should meet the applicable local standards for window guards.

The use of Lexan windows in the geophysical seismic industry is quite widespread, as machinery used in the industry has gone to 'full cab' configurations. These configurations help meet safety requirements, increase operator outward visibility and at the same time, increase operator comfort (i.e. dust free, heated and air conditioned cabs).

The following are recommendations in response to a series of incidents involving Lexan windows.

- 1) A Lexan window should be changed if:
 - it is four or more years old (regardless of how it may look)
 - it has become yellowed or hazed
 - it has scratches on either side that can be felt with a fingernail
 - there are small cracks coming from the mounting holes or in the surface area of the window
 - it has come into contact with any fluids that have caused cloudiness

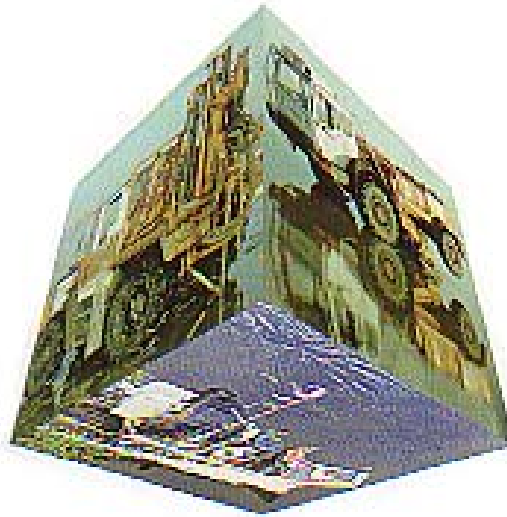
- 2) While a certain thickness of Lexan will stop a bullet, it will not prevent a tree of sufficient size from crashing into a cab. In situations where there is potential for this to happen, metal screens are needed in conjunction with the Lexan window(s).
- 3) Operators and Employers should be aware that when it is extremely cold i.e. -20C or below, the Lexan window's resistance to shattering is lessened as it becomes 'brittle' at these temperatures.
- 4) Operators should be periodically alerted to these issues regarding Lexan windows at safety meetings and prior to performing inspections. All units equipped with Lexan windows should be regularly inspected with the above criteria in mind.

12.2.6.3 High-Speed Drums

The following is recommended for Mulchers equipped with rotating drums that spin at high rates of speed (often in excess of 1700 rpms).

- 1) The drum and teeth should be inspected regularly to ensure that they are in good working condition.
- 2) Any damage or breakages should be repaired as soon as possible.
- 3) Unless the mulcher is equipped with rock crushing capability, areas that contain rocks that are liable to damage the drum or teeth should not be mulched.
- 4) Operators should be periodically alerted to these high-speed drum issues at safety meetings and prior to performing inspections. All units should be regularly inspected with the above criteria in mind.

13. CRANES & LIFTING DEVICES



13 CRANES AND LIFTING DEVICES



other lifting devices.

- 4) Always ensure that all slings, hooks, wirelines, cables, and tag lines are secure and in good working order. A lifting register should be kept and all inspections should be logged within.

Most geophysical crews, in operation today, have a variety of power lifting equipment available to assist in material handling and machinery servicing. These devices are provided to expedite the handling of heavy loads and should be operated in accordance with certain safety guidelines.

- 1) Only trained and qualified persons shall operate the crane. Auxiliary personnel, working in the area of cranes and cargo, shall be instructed and familiar with required Personal Protective Equipment (PPE), the operation and safe procedures for this equipment.

- 2) The operator should examine the crane foundation, cables, drum, dogs, brakes, boom, guard, pins, sheaves, load hook, and wireline for defects. Any defects should be repaired before the crane is used. Crane hooks that are defective should be replaced. Repair by welding or otherwise should not be attempted. A prepared inspection checklist is most helpful for this task.

- 3) All cranes, winches, and other hoisting devices should be certified and checked at regular intervals. The Safe Working Load (SWL) should be prominently displayed on the boom of any crane and clearly marked on all

These documents kept for reference. Slings, fittings, and fastenings should be inspected before, during, and after daily use. Equipment found to be defective should be discarded. The date that the slings are placed in service should be stenciled on the metal eye.

- 5) The maximum capacity and boom angle of the crane should be clearly marked and should not be exceeded. This information will be found on the lift chart that shall be mounted on the crane within sight of the operator. Boom-angle indicators should be permanently attached to the boom in order to show the operating radius.
- 6) Crane hooks shall have safety latches. Stops should be provided on all crane booms in order to prevent the possibility of overtopping the boom.
- 7) The crane operator and auxiliary personnel should be mindful of overhead obstacles and hazards that may contact the crane boom. Power lines represent a serious lethal hazard that should be avoided.
- 8) A hand signal chart shall be mounted to the crane foundation or other location close by and visible to the operator.
- 9) A qualified designated signal person should work with the crane operator. Standard signals should be used. Normally all signals should be given by the signal person, but the operator should obey an emergency stop signal given by anyone. If standard signals are not utilized, the signaling method should be agreed upon by the crane operator and auxiliary personnel before commencement of the crane operators.
- 10) The operator should properly secure the crane and boom before going off duty, or when shutting down operations. The mechanic should be notified if any defects are known.
- 11) All personnel should be instructed in safe operating procedures before handling cargo.
- 12) Personal Protective Equipment (PPE) should be worn by all personnel handling cargo and working around cranes. This equipment should include hard hats, safety boots with non-slip soles, leather gloves, and any other safety equipment that might be required to handle any other specific cargo.
- 13) Correct cargo handling tools should be used, and these tools should be regularly checked and maintained.
- 14) Cargo handling involving the use of cranes and hoists should always be considered a hazardous job, and never be attempted by only one person.
- 15) Always watch the loads in the process of being lifted by cranes. Your eyes should be on the cargo until it is on deck and disconnected from the crane.
- 16) Never get under a suspended cargo load, and never get any part of your body between unsecured objects (pinch points). Weather conditions and vehicle movement may cause suspended cargo to swing.

- 17) Ample tag lines should be used to guide all loads regardless of weight, load size or weather conditions.
- 18) When strain is being placed on a rope, line, or cable, never stand in the path it would follow should it part. Never stand in the path the load would follow should the lifting cable break.
- 19) Never wear loose clothing when near rotating machinery. Never handle rope or cables when wearing a ring.
- 20) Never ride on a load being hoisted.
- 21) Take extra care when loading oxygen, acetylene, other flammable gases and any other substance that may be considered hazardous.
- 22) Deck or ground openings in the lifting area should have chain guards, railings or barriers around them.
- 23) Personnel should be alert when handling cargo and working around cranes and hoists.

13.1 Dealing with Slings

- 1) Do not use knots to make slings.
- 2) Pad or block sharp corners.
- 3) Lift and lower loads slowly without jerking.
- 4) Use slings of adequate capacity and construction. Consult the specifications.
- 5) Know how much weight you are lifting.

13.2 11.2 Required Inspections

- 1) All lifting tackle should be formally examined by a competent person on a regular basis. This should not exceed a 12-month period, depending on frequency, type of use, and environmental conditions.
- 2) Visual inspection prior to and after use is a requirement.
- 3) Any proof loading shall be carried out by a competent person in accordance with the relevant Standard or the manufacturer's recommendations

13.3 Signs of Defective Wire Rope Slings

- 1) Ten randomly broken wires in one rope lay or five broken wires in one strand in one lay.
- 2) Wearing or scraping of one-third of the original diameter of the outside wires.
- 3) Kinking, gouging, bird caging or other damage.
- 4) Evidence of corrosion or heat damage.
- 5) End attachments that are cracked, rusted, or deformed.
- 6) Splices.

13.4 Signs of defective Web Slings

- 1) Missing or illegible sling identification (required: manufacturer ID, code or stock number, rated capacity for hitches, core and cover material)
- 2) Chemical damage (acid or caustic burns, brittle or stiff areas, unexplained discoloration)
- 3) Melting, charring, weld or slag spatter, or other evidence of exposure to a heat source;
- 4) Holes, tears, cuts or snags
- 5) Missing stitching, or abrasion that exposes the inner core of the sling
- 6) Knotting
- 7) Damage to the fittings (stretching, cracking, pitting, or distortion)
- 8) Any other visible damage that might compromise the strength of the sling

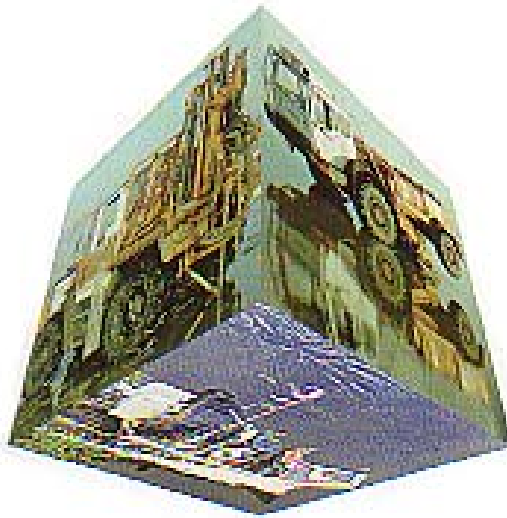
13.5 Signs of defective rope slings

- 1) Cuts, gouges, wear etc., that reduces the effective diameter of the rope by more than 10%
- 2) Powdered fiber between strands
- 3) Broken, cut, melted or charred fibers
- 4) Chemical or ultraviolet damage
- 5) Foreign material that has permeated the rope (e.g. grit, sand, paint)
- 6) Kinks or distortion in the rope structure
- 7) Corrosion, cracks, distortion or wear in thimbles and other hardware and fittings
- 8) Missing identification and other visible damage that could affect sling strength

13.6 Signs of defective chain slings

- | | |
|---|---|
| 1) Chain links and attachments do not hinge freely | 5) The existence of cracks, nicks, breaks, weld spatter, signs of exposure to excessive temperature, and excessive wear |
| 2) Links excessively worn or links cracked or twisted | |
| 3) Signs of excessive stretching | 6) The above should be checked when inspecting fittings, attachments and hooks. |
| 4) Excessive corrosion | |

14. FIRST AID



14 FIRST AID

The text has been changed to align with latest recommendations from UK Resuscitation Council which is the basis to many of the 1st and advanced aid training packages being provided.

<http://www.resus.org.uk/>

FIRST AID AWARENESS



What is First Aid:

First Aid is the assistance or treatment given to a casualty for any injury or sudden illness before the arrival of an ambulance or qualified medical expert. It may involve improvising with facilities and materials available at the time.

Aim of First Aid

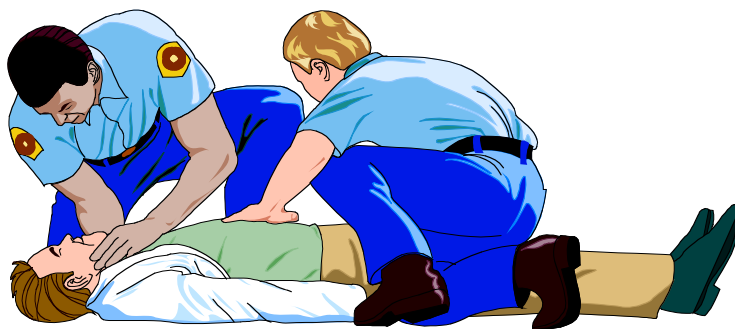
First Aid treatment is given to a casualty in order:

- To preserve life
- To prevent the condition from worsening
- To promote recovery

PROTECT-EXAMINE-ALERT

You should assess the situation and

- 1) Protect
- 2) Examine
- 3) Alert



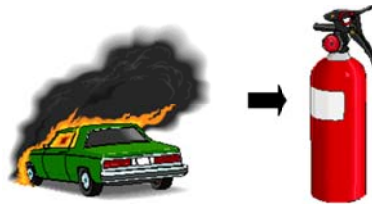
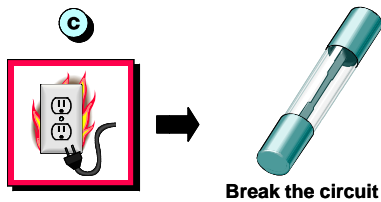
Only after having performed these 3 steps will you actually provide First Aid.

1. PROTECT

Protect yourself and the injured person

Avoid another accident by eliminating the cause:

- Turn-off the electricity to equipment
- Have someone control traffic
- Keep bystanders away from the scene of the accident
- Extinguish fire if possible without putting yourself in danger
- Protect yourself against blood borne pathogens (AIDS, Hepatitis)



2. EXAMINE THE VICTIM

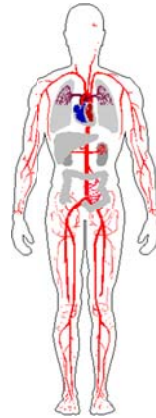


- A. Look for severe external **bleeding**
- B. Check for **responsiveness** and **unconsciousness**
- C. Check for **breathing**
- D. Check for **circulation**

2.1. EXAMINE

A. Look for severe external bleeding

- Loss of blood may be fatal
- Arterial bleeding from the femoral artery can cause death in two minutes!



2.2. EXAMINE

B. Check For Responsiveness/ Unconsciousness

Ask simple questions

"Can you hear me?"

Give simple orders

"Press my hand."



If there is no reply and no response, the victim is unconscious.

2.3. EXAMINE

C. Check For Breathing

Look – Listen - Feel



2.4. EXAMINE

D. Check Circulation/Pulse

Until recently, the rule was to check for the carotid pulse.

THIS IS NO LONGER THE RULE - This has now been abandoned in the revised First Aid international recommendations due to the fact that many first aiders were not able to find a pulse when faced with an emergency situation.

One should consider that there is no pulse if the victim:

1. is unconscious and
2. is not breathing and
3. has no reaction (coughing or body movements).

3. ALERT

Call for assistance or have someone alert the emergency medical service rapidly. Always provide:

- Exact location or address of the accident or incident
- Telephone number where you can be called
- How many people are involved
- Nature of injuries (fractures, burns, etc.)
- Indication of the seriousness of the injuries (breathing or not, etc.)
- What first aid has been given



Do not hang up until you are sure that the person at the other end has all the info and have them repeat the address to send assistance.

4. TREAT THE VICTIM

1. Control Blood Loss

2. Open the **Airway**

3. Give **External Chest Compressions**

4. Give **Artificial Ventilations**

}

CPR

5. Place in the **Recovery Position**

6. Keep under **Observation**

4.1. TREATING: Control Blood Loss

A. For important but non-complicated external bleeding:

Apply **direct pressure** on the wound.

Avoid direct contact with blood (gloves, gauze, handkerchief, etc.)



4.2. TREATING: Control Blood Loss

B. For important and complicated external bleeding (associated with a fracture or foreign body):

Use **indirect pressure**.

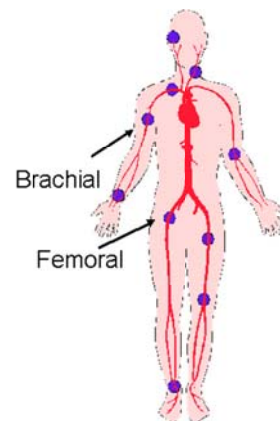
This requires applying pressure
to the appropriate **pressure point**.

Brachial pressure point = Inner part of the upper arm

(Used to stop bleeding in hand, forearm and arm)

Femoral pressure point = Groin

(Used to stop bleeding in thigh, leg, foot)

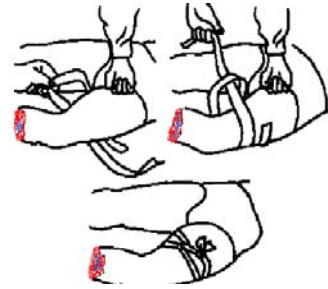


4.3. TREATING: Control Blood Loss

C. Tourniquet

Place a Tourniquet **ONLY** if:

- Bleeding is profuse and the pressure point is ineffective or impossible to achieve.
- You are alone and cannot apply a pressure point and perform CPR at the same time.
- There is no other choice as in the case of an amputated limb.



Lay the injured person down. Note the time at which the tourniquet was placed, and write it on his forehead.

NEVER REMOVE A TOURNIQUET ONCE IT HAS BEEN PLACED.

a. TREATING: Adult Basic CPR

Adult basic life support sequence

Basic life support consists of the following sequence of actions:

1. Make sure the victim, any bystanders, and you are safe.

2. Check the victim for a response.

- Gently shake his shoulders and ask loudly, 'Are you all right?'

3A. If he responds:

- Leave him in the position in which you find him provided there is no further danger.
- Try to find out what is wrong with him and get help if needed.
- Reassess him regularly.

3B. If he does not respond:

- Shout for help.
- Turn the victim onto his back and then open the airway using head tilt and chin lift:
 - Place your hand on his forehead and gently tilt his head back.
 - With your fingertips under the point of the victim's chin, lift the chin to open the airway.

Look – Listen - Feel



4. Keeping the airway open, look, listen, and feel for normal breathing.

- Look for chest movement.
- Listen at the victim's mouth for breath sounds.
- Feel for air on your cheek.

In the first few minutes after cardiac arrest, a victim may be barely breathing, or taking infrequent, noisy, gasps. This is often termed agonal breathing and should not be confused with normal breathing.

Look, listen, and feel for **no more** than **10 s** to determine if the victim is breathing normally. If you have any doubt whether breathing is normal, act as if it is **not** normal.

5A. If he is breathing normally:

- Turn him into the recovery position (**see below**).
- Summon help from the ambulance service by mobile phone. If this is not possible, send a bystander. Leave the victim only if no other way of obtaining help is possible.
- Continue to assess that breathing remains normal. If there is any doubt about the presence of normal breathing, start CPR (5B).

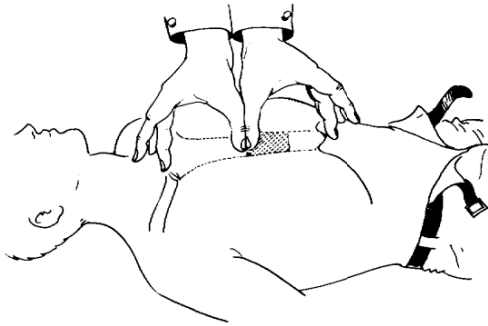
5B. If he is not breathing normally:

- Ask someone to call for an ambulance and bring an AED if available. If you are on your own, use your mobile phone to call for an ambulance. Leave the victim only when no other option exists for getting help.
- Start chest compression as follows:
 - Kneel by the side of the victim.
 - Place the heel of one hand in the centre of the victim's chest (which is the lower half of the victim's sternum (breastbone)).
 - Place the heel of your other hand on top of the first hand.
 - Interlock the fingers of your hands and ensure that pressure is not applied over the victim's ribs. Do not apply any pressure over the upper abdomen or the bottom end of the sternum.
 - Position yourself vertically above the victim's chest and, with your arms straight, press down on the sternum 5 - 6 cm.

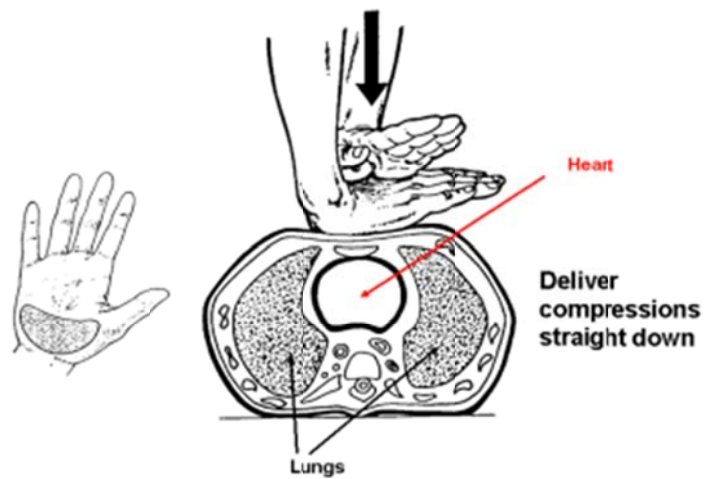
- After each compression, release all the pressure on the chest without losing contact between your hands and the sternum.

Locating the External Chest Compression site:

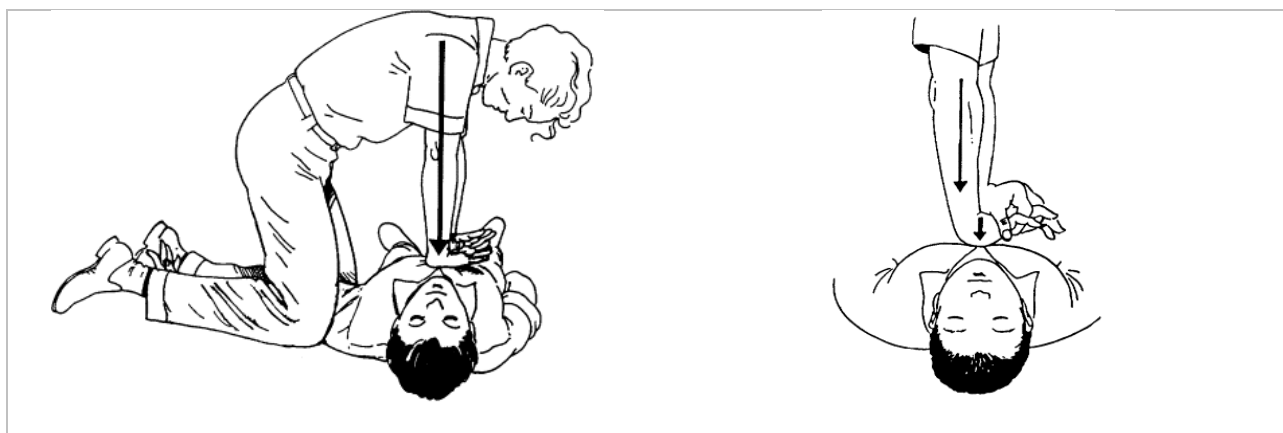
Center of the breastbone



Use the heel of the hand



ECC = 100 – 120 compressions per minute (adult)



Repeat at a rate of 100 - 120 min⁻¹.

- o Compression and release should take an equal amount of time.

6A. Combine chest compression with rescue breaths:

- After 30 compressions open the airway again using head tilt and chin lift.
- Pinch the soft part of the victim's nose closed, using the index finger and thumb of your hand on his forehead.
- Allow his mouth to open, but maintain chin lift.
- Take a normal breath and place your lips around his mouth, making sure that you have a good seal.
- Blow steadily into his mouth whilst watching for his chest to rise; take about one second to make his chest rise as in normal breathing; this is an effective rescue breath.
- Maintaining head tilt and chin lift, take your mouth away from the victim and watch for his chest to fall as air comes out.
- Take another normal breath and blow into the victim's mouth once more to give a total of two effective rescue breaths. The two breaths should not take more than 5 s. Then return your hands without delay to the correct position on the sternum and give a further 30 chest compressions.
- Continue with chest compressions and rescue breaths in a ratio of 30:2.
- Stop to recheck the victim only if he starts to show signs of regaining consciousness, such as coughing, opening his eyes, speaking, or moving purposefully AND starts to breathe normally; otherwise **do not interrupt resuscitation**.

If the initial rescue breath of each sequence does not make the chest rise as in normal breathing, then, before your next attempt:

- Check the victim's mouth and remove any visible obstruction.
- Recheck that there is adequate head tilt and chin lift.
- Do not attempt more than two breaths each time before returning to chest compressions.

If there is more than one rescuer present, another should take over CPR about every 1-2 min to prevent fatigue. Ensure the minimum of delay during the changeover of rescuers, and do not interrupt chest compressions.

6B. Compression-only CPR

- If you are not trained to, or are unwilling to give rescue breaths, give chest compressions only.
- If chest compressions only are given, these should be continuous at a rate of 100 - 120 min⁻¹.
- Stop to recheck the victim only if he starts to show signs of regaining consciousness, such as coughing, opening his eyes, speaking, or moving purposefully AND starts to breathe normally; otherwise **do not interrupt resuscitation**.

7. Continue resuscitation until:

- qualified help arrives and takes over,
- the victim starts to show signs of regaining consciousness, such as coughing, opening his eyes, speaking, or moving purposefully AND starts to breathe normally, OR
- you become exhausted.

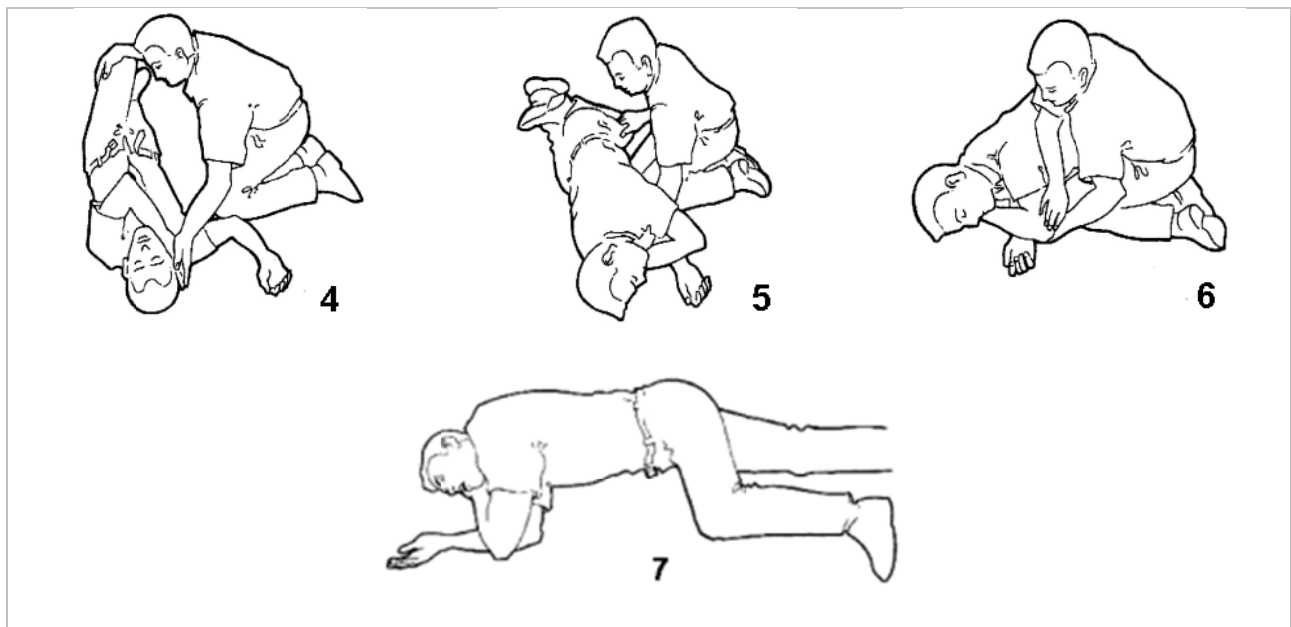
4.13. TREATING: The Recovery Position

For the unconscious casualty who is breathing and is reactive. Prevents obstruction of the airway by saliva or the tongue.



4.13. TREATING: The Recovery Position

The flexed leg is used as a control lever to facilitate body rotation.

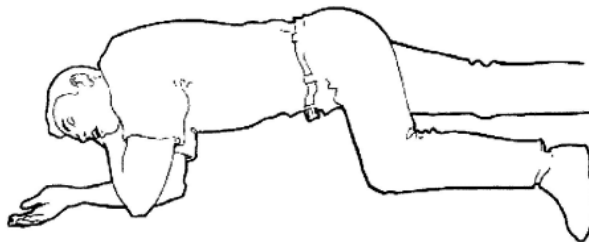


4.14. TREATING: Keep Under Observation

Check breathing, consciousness and reactivity every few minutes

Cover the victim with a blanket to keep him warm and avoid shock

Stay with the victim until emergency services arrive



5. OTHER BASIC THINGS TO KNOW

Other Injuries

- Choking
- Burns
- Fractures
- Bites



Moving the Casualty

- When?
- How?

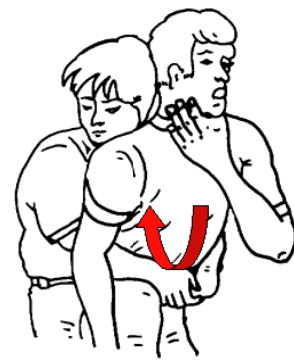
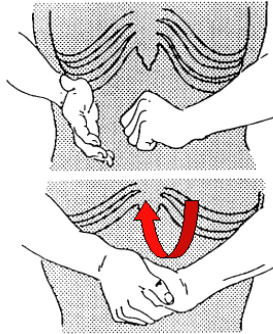


5.1. OTHER INJURIES: Choking

Choking = Airway obstruction

5 good taps on the back first

If no result => Heimlich Maneuver

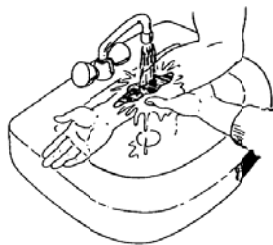


5.2. OTHER INJURIES: Burns

Thermal & Chemical Burns

Carefully remove clothing, especially when chemicals are involved.

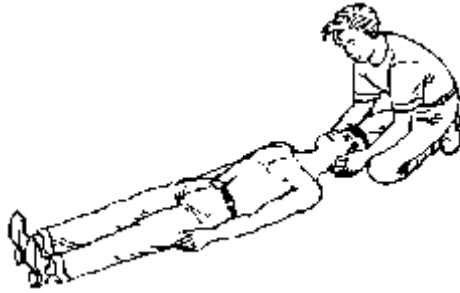
Cool the burnt area with cold water or other non-inflammable liquid (milk, etc.) for at least 10 minutes.



5.3. OTHER INJURIES: Fractures

Immobilize the fractured limb

Immobilize the head if a fracture of the neck is suspected

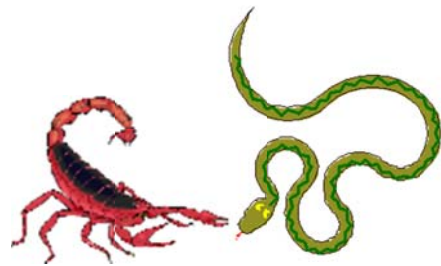


Whenever possible, never move an injured person before immobilization of fractured bone.

5.4. OTHER INJURIES: Bites

Snake bites and Scorpion stings

- Immobilize entire limb
- Calm the victim
- Advise the victim not to move
- Transport to medical facility
- Do not cut or suck wound
- Anti-snake venom should only be given by a doctor



5.5. MOVING A CASUALTY URGENTLY: When?

When?

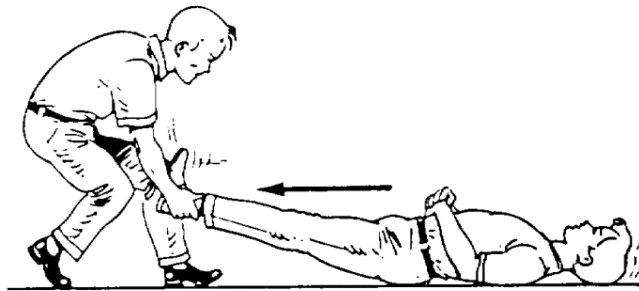
Only when the life of the injured person (and sometimes of the rescuer) is in greater danger than if not removed.



5.6. MOVING A CASUALTY: How?

If you are alone and there is a flat surface =

The Foot Drag



5.7. MOVING A CASUALTY: How?

If you are alone and there are obstacles on the ground =

The Wrist Drag



5.8. MOVING A CASUALTY: How?

If you are alone and need to get the victim out of the vehicle.

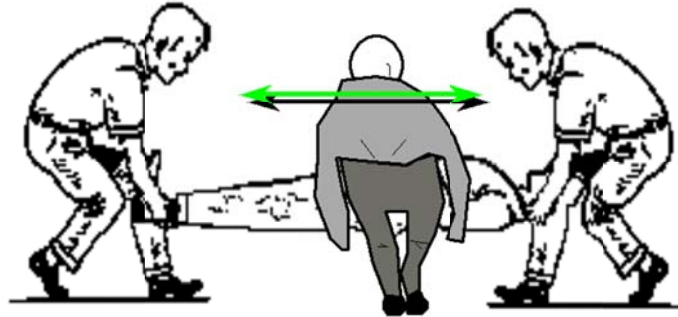


Switch off ignition.

Look at the car damage. It will indicate how severely the person is injured.

5.9. MOVING A CASUALTY: How?

If more than one first aider = **Move as a block**



Always ask yourself if it is really necessary to move the injured person?